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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

XIII. FROM FETICH TO HYGIENE.

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PART I.

ONE of the most striking features in recorded history down to a recent period has been the recurrence of great pestilences. Various indications in ancient times show their frequency, and the famous description of the plague of Athens given by Thucydides, with the discussion of it by Lucretius, show their severity. In the middle ages they raged from time to time throughout Europe; such plagues as the black death and the sweating sickness swept off vast multitudes, the best authorities estimating that of the former, at the middle of the fourteenth century, more than half the population of England died, and that twenty-five millions of people perished in various parts of Europe. In 1552 sixty-seven thousand patients died of the plague in the Hôtel-Dieu at Paris alone, and in 1580 more than twenty thousand. The great plague in England and other parts of Europe in the seventeenth century was also fearful; and that which swept the south of Europe in the early part of the eighteenth century, as well as the invasion of the cholera at various times during the nineteenth, while less terrible than their predecessors, have still left a deep impress upon the imaginations of men.

From the earliest records we find that such pestilences were attributed to the wrath or malice of unseen powers. This had been the view of the heathen even in the most cultured ages before the establishment of Christianity; in Greece and Rome especially, plagues of various sorts were attributed to the wrath of the gods; in Judea, the Scriptural records of various plagues sent

upon the earth by the divine fiat as a punishment for sin show the continuance of this mode of thought. Among many examples and intimations of this in our sacred literature, we have the epidemic which carried off fourteen thousand seven hundred of the children of Israel, and which was only stayed by the prayers and offerings of Aaron, the high priest; the destruction of seventy thousand men in the pestilence by which King David was punished for the numbering of Israel, and which was only stopped when the wrath of God was averted by burnt-offerings; the plague threatened by the prophet Zechariah, and that delineated in the Apocalypse. From these sources this current of ideas was poured into the early Christian Church, and hence it has been that during nearly twenty centuries since the rise of Christianity, and down to a period within living memory, at the appearance of any pestilence the church authorities, instead of devising sanitary measures, have very generally preached the necessity of immediate atonement for offenses against the Almighty.

This view of the early Church was enriched greatly by a new development of theological thought regarding the powers of Satan and evil angels. For this, the declaration of St. Paul that the gods of antiquity were devils, was cited as sufficient warrant.*

Moreover, comets, falling stars, and earthquakes were thought upon Scriptural authority to be "signs and wonders"—evidences of the divine wrath, heralds of fearful visitations; and this belief acting powerfully upon the minds of millions of men, did much to create a panic-terror sure to increase the disease wherever it broke forth.

The main cause of this immense sacrifice of life is now known to have been the want of hygienic precautions, both in the Eastern centers where various plagues were developed, and in the European towns through which they spread. And here certain theological reasonings came in to resist the evolution of a proper sanitary theory. Out of the Orient had been poured into the thinking of western Europe the theological idea that the abasement of man adds to the glory of God; that indignity to the body may secure

* For plague during the Peloponnesian wars, see Thucydides, ii, 47–55, and iii, 87. For a general statement regarding this and other plagues in ancient times, see Lucretius, vi, 1090 *et seq.*; and for a translation, see vol. i, p. 325, in Munro's edition of 1864. For early views of sanitary science in Greece and Rome, see Forster's Inquiry in the Pamphleteer, xxiv, 404. For the Greek view of the interference of the gods in disease, especially in pestilence, see Grote's History of Greece, vol. i, pp. 251 and 485, and vol. vi, p. 213; see also Herodotus, lib. iii, xxxiv, and elsewhere. For the Hebrew view of the same interference by the Almighty, see especially Numbers, xi, 4–34; also xvi, 49; 1 Samuel, xxiv; also Psalm cvi, 29; also the well-known texts in Zechariah and Revelations. For St. Paul's declaration that the gods of the heathen were devils, see 1 Cor., x, 20. As to the earlier origin of the plague in Egypt, see Haeser, Lehrbuch der Geschichte der Medicin und der epidemischen Krankheiten, Jena, 1875–'82, vol. iii, pp. 15 *et seq.*

salvation to the soul; hence that cleanliness betokens pride, and filthiness humility. Living in filth was regarded by great numbers of holy men, who set an example to the Church and society, as an evidence of sanctity. St. Jerome and the Breviary of the Roman Church dwell with unction on the fact that St. Hilarion lived his whole life long in utter physical uncleanness; St. Athanasius glorifies St. Anthony because he had never washed his feet; St. Abraham's most striking evidence of holiness was that for fifty years he washed neither his hands nor his feet; St. Sylvia never washed any part of her body save her fingers; St. Euphraxia belonged to a convent in which the nuns religiously abstained from bathing; St. Mary, of Egypt, was eminent for filthiness; St. Simon Stylites was in this respect unspeakable—the only thing that can be said is, that he lived in ordure and stench intolerable to his visitors. The Lives of the Saints dwell with complacency on the statement that when sundry Eastern monks showed a disposition to wash themselves, the Almighty manifested his displeasure by drying up a neighboring stream until the bath which it had supplied was destroyed.

The religious world was far indeed from the inspired utterance attributed to John Wesley, that "cleanliness is near akin to godliness." For century after century the idea prevailed that filthiness was akin to holiness, and while we may well believe that the devotion of the clergy to the sick was a main cause why, during the greater plagues, they lost so large a proportion of their numbers, we can not escape the conclusion that their want of cleanliness had much to do with it; in France, during the fourteenth century, Guy de Chauliac, the great physician of his time, noted particularly that certain Carmelite monks suffered especially from pestilence, and that they were especially filthy; during the black death no less than nine hundred Carthusian monks fell victims in one group of buildings.

Naturally, such an example set by the venerated leaders of thought exercised great influence throughout society, and all the more because it justified the carelessness and sloth to which ordinary humanity is prone. In the principal towns of Europe, as well as in the country at large, down to a recent period, the most ordinary sanitary precautions were neglected, and pestilences continued to be attributed to the wrath of God or the malice of Satan. As to the wrath of God, a new and powerful impulse was given to this belief in the Church toward the end of the sixth century by St. Gregory the Great. In 590, when he was elected Pope, the city of Rome was suffering from a dreadful pestilence: the people died by thousands; out of one procession imploring the mercy of Heaven, no less than eighty persons died within an hour; what the heathen in an earlier epoch had attributed to

Apollo, was now attributed to Jehovah, and chroniclers tell us that fiery darts were seen flung from heaven into the devoted city; but finally, in the midst of all this horror, Gregory, at the head of a penitential procession, saw hovering over the mausoleum of Hadrian the figure of the archangel Michael, who was just sheathing a flaming sword, while three angels were heard chanting the "Regina Cœli." The legend continues that the Pope immediately broke forth into hallelujahs for this sign that the plague was stayed; and as it shortly afterward became less severe, a chapel was built at the summit of the mausoleum and dedicated to St. Michael; still later, above the whole was erected the colossal statue of the archangel sheathing his sword, which still stands to perpetuate the legend. Thus the greatest of Rome's ancient funeral monuments was made to bear testimony to this mediæval belief; the mausoleum of Hadrian became the castle of St. Angelo. A legend like this, claiming to date from the greatest of the early popes, and vouched for by such an imposing monument, had undoubtedly a vast effect upon the dominant theology throughout Europe, which was constantly developing a great body of thought regarding the agencies by which the divine wrath might be averted.

First among these agencies naturally were evidences of devotion, especially gifts of land, money, or privileges to churches, monasteries, and shrines—the seats of fetiches which it was supposed had wrought cures or might work them. The whole evolution of modern history, not only ecclesiastical but civil, has been largely affected by the wealth transferred to the clergy at such periods. It was noted that after the great plague in the fourteenth century, the black death, had passed, an immensely increased proportion of the landed and personal property of every European country was in the hands of the Church; well did a great ecclesiastic remark that "pestilences are the harvests of the ministers of God."*

Other modes of propitiating the higher powers were penitential processions, the parading of images of the Virgin or of saints

* For triumphant mention of St. Hilarion's filth, see the Roman Breviary for October 21st; and for details, see S. Hieronymus, Vita S. Hilarionis Eremitæ, Migne Patrologia, tome 23. For the filthiness of the other saints named, see citations from Lives of the Saints in Lecky's History of European Morals, vol. ii, pp. 117, 118. For Guy de Chauliac's observation on the filthiness of Carmelite monks and their great losses by pestilence, see Meryon, History of Medicine, vol. i, p. 257. For the mortality among the Carthusian monks in time of plague, see Mrs. Lecky's very interesting Visit to the Grand Chartreuse, in The Nineteenth Century for March, 1891. For the plague at Rome in 590, the legend regarding the fiery darts, mentioned by Gregory of Tours, and that of the castle of St. Angelo, see Gregorovius, Geschichte der Stadt Rom im Mittelalter, vol. ii, pp. 26, 35. Also, Story, Castle of St. Angelo, etc., chap. ii. For the remark that "pestilences are the harvest of the ministers of God," see Charlevoix, given in Southey, History of Brazil, vol. ii, p. 254, cited in Buckle, vol. i, p. 130, note.

through plague-stricken towns, and innumerable fetiches. Very noted in the thirteenth and fourteenth centuries were the processions of the flagellants, trooping through various parts of Europe, scourging their naked bodies, and shrieking the penitential psalms, often running from wild excesses of devotion to the maddest orgies.

Sometimes, too, plagues were attributed to the wrath of lesser heavenly powers: just as, in former times, the fury of far-darting Apollo was felt when his name was not respectfully treated by mortals, so in 1680 the church authorities at Rome discovered that the plague then raging resulted from the anger of St. Sebastian, because no monument had been erected to him; such a monument was therefore placed in the church of St. Peter ad Vincula, and the plague ceased.

So much for the endeavor to avert the wrath of the heavenly powers. On the other hand, theological reasoning no less subtle was used in thwarting the malice of Satan. This idea, too, came from far. In the sacred books of India and Persia, as well as in our own, we find the same theory of disease, leading to similar means of cure. Perhaps the most astounding among Christian survivals of this theory and its resultant practices was seen during the plague at Rome in 1522. In that year, at that center of divine illumination, certain people, having reasoned upon the matter, came to the conclusion that this great scourge was the result of satanic malice; and in view of St. Paul's declaration that the ancient gods were devils, and of the theory that the ancient gods of Rome were the devils who had the most reason to punish that city for their dethronement, and that the great amphitheatre was the chosen haunt of these demon gods, an ox decorated with garlands, after the ancient heathen manner, was taken in procession to the Colosseum and solemnly sacrificed. Even this proved vain, and the church authorities then ordered expiatory processions and ceremonies to propitate the Almighty, the Virgin, and the saints, who had been offended by this temporary effort to bribe their enemies.

But this sort of theological reasoning developed an idea far more disastrous, and this was that Satan, in causing pestilences, used as his emissaries especially Jews and witches. The proof of this belief in the case of the Jews was seen in the fact that they escaped with a less percentage of disease than did the Christians in the great plague periods. This was doubtless due in some measure to their remarkable sanitary system, which had probably originated thousands of years before in Egypt, and had been handed down through Jewish lawgivers and statesmen. Certainly they observed more careful sanitary rules and more constant abstinence from dangerous foods than was usual among Christians; but the public at large could not understand so simple

a cause, and jumped to the conclusion that their immunity resulted from protection by Satan, and that this favor was repaid and the pestilence caused by their wholesale poisoning of Christians. As a result of this mode of thought, attempts were made in all parts of Europe to propitiate the Almighty, to thwart Satan, and stop the plague by torture and murder of the Jews. Throughout Europe during great pestilences we hear of extensive burnings of this devoted people. In Bavaria, at the time of the "black death," it is computed that twelve thousand Jews thus perished; in the small town of Erfurt, the number is said to have been three thousand; in Strasburg the Rue Brulée remains as a monument to the two thousand Jews burned in it for poisoning the wells and causing the plague of 1348; at the royal castle of Chinon, near Tours, an immense trench was dug, filled with blazing wood, and in a single day one hundred and sixty Jews were burned. Everywhere in continental Europe this mad persecution went on; but it is a pleasure to say that one man, Pope Clement VI, stood against this mass of popular unreason, and, so far as he could bring his influence to bear on the maddened populace, it was exercised in favor of mercy to these supposed enemies of the Almighty.*

As to witches, the reasons for believing them the cause of pestilence also came from far. This belief, too, had been poured into the early Church from Oriental sources, and was strengthened by a whole line of church authorities, fathers, doctors, and saints; but, above all, by the great bull, "Summis Desiderantes," issued by Pope Innocent VIII, in 1484. This utterance from the seat of St. Peter infallibly committed the Church to the idea that witches are a great cause of disease, storms, and various ills which

* For an early conception in India of the Divinity acting through medicine, see The Bhagavadgîtâ, translated by Telang, p. 82, in Max Müller's Sacred Books of the East. For the necessity of religious means of securing knowledge of medicine, see the Anagîtâ, translated by Telang, in Max Müller's Sacred Books of the East, p. 388. For ancient Persian ideas of sickness as sent by the spirit of evil and to be cured by spells, but not excluding medicine and surgery, and for sickness generally as caused by the evil principle in demons, see the Zend-Avesta, Darmesteter's translation, in Max Müller's Sacred Books of the East, introduction *passim*, but especially xcii. For diseases wrought by witchcraft, see Zend-Avesta, Darmesteter's translation, pp. 230 and 293. On the preference of spells in healing over medicine and surgery, see Zend-Avesta, vol. i, pp. 85, 86. For healing by magic in ancient Greece see, e. g., the cure of Ulysses in the Odyssey, "They stopped the black blood by a spell" (Odyssey, xix, 457). For medicine in Egypt as partly priestly and partly in the hands of physicians, see Rawlinson's Herodotus, vol. ii, p. 136, note. For ideas of curing of diseases by expulsion of demons still surviving among various tribes and nations of Asia, see J. G. Frazer, The Golden Bough, a Study of Comparative Religion, London, 1890, pp. 184–192. For the flagellants and their processions at the time of the black death, see Lea, History of the Inquisition, New York, 1888, vol. ii, p. 381 *et seq.* For the persecution of the Jews in time of pestilence, see ibid., p. 379 and following, with authorities in the notes.

afflict humanity, and the Scripture on which the action recommended against witches in this papal bull, as well as in so many sermons and treatises for centuries afterward, was based, was the famous text, "Thou shalt not suffer a witch to live." This idea persisted long; and the evolution of it is among the most fearful things in human history.*

In Germany this development was especially terrible. From the middle of the sixteenth century to the middle of the seventeenth, Catholic and Protestant theologians and ecclesiastics vied with each other in detecting witches guilty of producing sickness or bad weather; women were sent to torture and death by thousands, and with them, from time to time, men and children. On the Catholic side sufficient warrant for this work was found in the bull of Pope Innocent VIII, and the bishops' palaces of south Germany became shambles—the lordly prelates of Salzburg, Würzburg, and Bamberg taking the lead in this butchery.

In north Germany Protestantism was just as conscientiously cruel. It based its theory and practice toward witches directly upon the Bible, and above all on the great text which has cost the lives of so many myriads of innocent men, women, and children: "Thou shalt not suffer a witch to live." Naturally the Protestant authorities strove to show that Protestantism was

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* On the plagues generally, see Hecker, Epidemics of the Middle Ages, *passim*; but especially Haeser, as above III. Band, s., pp. 1–202; also, Sprengel, Baas, Isensee, *et al.* For brief statement showing the enormous loss of life in these plagues, see Littré, Médecine et Médecins, Paris, 1875, p. 3 *et seq.* For a summary of the effects of the Black Plague throughout England, see Green's History of the English People, chap. v. For the mortality in the Paris hospitals, see Desmazes, Supplices, Prisons et Graces en France, Paris, 1866. For striking descriptions of plague-stricken cities, see the well-known passages in Thucydides, Bocaccio, De Foe, and above all, Manzoni's Promessi Sposi. For examples of averting the plagues by processions, see Leopold Delisle, Études sur la Condition de la Classe Agricole, etc., en Normandie au Moyen Age, p. 630; also Fort, chap. xxiii. For the anger of St. Sebastian as a cause of the Plague at Rome, and its cessation when a monument had been erected to him, see Paulus Diaconus, cited in Gregorovius, vol. ii, p. 165. For the sacrifice of an ox in the Colosseum to the ancient gods as a means of averting the plague of 1522, at Rome, see Gregorovius, vol. viii, p. 390. As to massacres of the Jews in order to averting the wrath of God in pestilence, see L'École et la Science, Paris, 1887, p. 178; also Hecker, and especially Hoeniger, Gang und Verbreitung des Schwarzen Todes in Deutschland, Berlin, 1880. As to absolute want of sanitary precautions, see Hecker, p. 292. As to condemnation by strong religionists of medical means in the plague, see Fort, p. 130. For a detailed account of the action of Popes Eugene IV and Innocent VIII against witchcraft, ascribing to it storms and diseases, and for the bull "Summis Desiderantes," see the chapter on Meteorology in this series. The text of the bull is given in the Malleus Maleficarum, in Binsfeld, and in Roskoff, Geschichte des Teufels, Leipzig, 1869, vol. i, pp. 222–225, and a good summary and analysis of it in Soldan, Geschichte der Hexenprocesse. For a concise and admirable statement of the contents and effects of the bull, see Lea, History of the Inquisition, vol. iii, pp. 40 *et seq.*; and for the best statement known to me of the general subject, Prof. George L. Burr's paper on witchcraft, read before the American Historical Association at Washington.

no less orthodox in this respect than Catholicism, and such theological jurists as Carpzov, Damhouder, and Calov did their work thoroughly; the most moderate of authorities on this subject places the number of victims thus sacrificed during that century in Germany alone at over a hundred thousand.

Among the methods of this witch activity especially credited in central and southern Europe was the anointing of city walls and pavements with a diabolical unguent causing pestilence. In 1530 Michael Caddo was executed with fearful tortures for thus besmearing the pavements of Geneva; but far more dreadful was the torturing to death of a large body of people at Milan, a hundred years later, for producing the plague by anointing the city walls. This case in Milan may be briefly summarized as showing the ideas of all classes from highest to lowest on sanitary science in the seventeenth century. That city was then under the control of Spain, and its authorities having received from the Spanish Government notice that certain persons suspected of witchcraft had recently left Madrid, and had perhaps gone to Milan to anoint the walls, this communication was dwelt upon in the pulpits as another evidence of that satanic malice which the Church alone had the means of resisting, and the people were thus excited and put upon the alert. One morning, in the year 1630, an old woman, looking out of her window, saw a man walking along the street and wiping his fingers upon the walls; she immediately called the attention of another old woman, and they agreed that this man must be one of the diabolical anointers. It was perfectly evident to a person under ordinary conditions that this unfortunate man was simply trying to remove from his fingers the ink gathered while writing from the ink-horn which he carried in his girdle; but this explanation was too simple to satisfy those who first observed him or those who afterward tried him: a mob was raised and he was thrown into prison. Being tortured, he at first did not know what to confess; but, on inquiring from the jailer and others, he learned what the charge was, and on being again submitted to torture utterly beyond endurance, he confessed everything which was suggested to him; and on being tortured again and again to give the names of his accomplices, he accused, at hazard, the first people in the city whom he thought of. These, being arrested and tortured beyond endurance, confessed and implicated a still greater number, until members of the foremost families were included in the charge. Again and again all these unfortunates were tortured beyond endurance. Under paganism the rule regarding torture had been that it should not be carried beyond human endurance; and we therefore find Cicero ridiculing it as a means of detecting crime, because a stalwart criminal

of strong nerves might resist it and go free, while a physically delicate man, though innocent, would be forced to confess. Hence it was that under paganism a limit was imposed to the torture which could be administered; but when Christianity had become predominant throughout Europe, torture was developed with a cruelty never before known. The theological doctrine of "excepted cases" was evolved—these "excepted cases" being heresy and witchcraft; for by a very simple and natural process of theological reasoning it was held that Satan would give supernatural strength to his special devotees—that is, to heretics and witches; and therefore, that in dealing with them there should be no limits to the torture. The result was in this particular case, as in tens of thousands besides, that the accused confessed everything which could be suggested to them, and often in the delirium of their agony confessed far more than all that the zeal of the prosecutors could suggest. Finally, a great number of worthy people were sentenced to the most cruel death which could be invented. The records of their trials and deaths are frightful. The treatise which in recent years has first brought to light in connected form an authentic account of the proceedings in this affair, and which gives at the end engravings of the accused submitting to horrible tortures on their way to the stake and at the place of execution itself, is one of the most fearful monuments of theological reasoning and human folly.

To cap the climax, after a poor apothecary had been tortured into a confession that he had made the magic ointment, and had been put to death with the most exquisite refinements of torture, his family were obliged to take another name, and were driven out from the city; his house was torn down, and on its site was erected "The Column of Infamy," which remained on this spot until, toward the end of the eighteenth century, a party of young radicals, probably influenced by the reading of Beccaria, sallied forth one night and leveled this pious monument to the ground.

Herein was seen the culmination and decline of the bull "Summis Desiderantes." It had been issued by him whom a vast majority of the Christian world believes to be infallible in his teachings to the Church as regards faith and morals; yet here was a deliberate utterance in a matter of faith and morals which even children now know to be utterly untrue. Though Beccaria's book on Crimes and Punishments, with its declarations against torture, was placed by the church authorities upon the Index, and though the faithful throughout the Christian world were forbidden to read it, even this could not prevent the victory of truth over this infallible utterance of Innocent VIII.*

* As to the fearful effects of the papal bull "Summis Desiderantes" in south Germany, on the Protestant severities in north Germany, and the immense number of women

As the seventeenth century went on, the whole ingenuity of the human mind in all parts of Europe seemed devoted to new developments of fetichism. A very curious monument of their further evolution in Italy is seen in the Royal Gallery of Paintings at Naples: upon the walls hang several pictures representing the measures taken to save the city from the plague during the seventeenth century, but especially from the plague of 1656. One enormous canvas gives a curious example of the theological doctrine of intercession between man and his Maker, spun out to its logical length: in the background is the plague-stricken city; in the foreground the people are praying to the city authorities to avert the plague; the city authorities are praying to the Carthusian monks; the monks are praying to St. Martin, St. Bruno, and St. Januarius; these three saints in their turn are praying to the Virgin; the Virgin prays to Christ, and Christ prays to the Almighty. Still another picture represents the people led by the priests executing with horrible tortures the Jews, heretics, and witches who were supposed to cause the pestilence of 1656, while in the heavens the Virgin and St. Januarius are interceding with Christ to sheathe his sword and stop the plague.

In such an atmosphere of thought it is no wonder that the death statistics are appalling. We hear of districts in which not more than one in ten escaped, and some were entirely depopulated. Such appeals to fetich against pestilence have continued in Naples down to our own time, the great saving power being the liquefaction of the blood of St. Januarius. In 1856 the present writer saw this miracle performed in the gorgeous chapel of the saint, forming part of the Cathedral of Naples. The chapel was filled with devout worshipers of every class, from the officials in court dress, representing the Bourbon king, down to the lowest lazzaroni. The reliquary of silver-gilt, shaped like a large human head, and supposed to contain the skull of the saint, was first placed upon the altar; next, two vials containing a dark substance said to be his blood, having been taken from the wall, were also placed upon the altar near the head. As the priests said masses and repeated the creeds, they turned the vials from time

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and children put to death for witchcraft in Germany generally, for spreading storms and pestilence, and for the monstrous doctrine of "excepted cases," see the standard authorities on witchcraft, especially Wächter, Beiträge zur Geschichte des Strafrechts, Soldan, Horst, Hauber, and others; also Burr, as above. In another series of Chapters on the Warfare of Humanity, I intend to go more fully into the subject. For the magic spreading of the plague at Milan, see Manzoni, I Promessi Sposi, and Colonna Infame; and for the origin of the charges with all the details of the trial, see the Processo Originale degli Untori, Milan, 1839, *passim*, but especially the large folding plate at the end, exhibiting the tortures. For the after-history of the Column of Infamy, and for the placing of Beccaria's book on the Index, see Cantu, Vita di Beccaria. For the magic spreading of the plague in general, see Littré, pp. 492 and following.

to time, and the liquefaction being somewhat delayed, the great mass of people burst out into expostulations and petitions to the saint, more and more impassioned. Just in front of the altar were the lazzaroni who claimed to be descendants of the saint's family, and these were especially importunate: at such times they beg, they scold, they even threaten; they have been known to abuse the saint roundly, and to tell him that, if he did not care to show his favor to the city by liquefying his blood, St. Cosmo and St. Damian were just as good saints as he, and would no doubt be very glad to have the city devote itself to them. At last, on the occasion of my visit, the priest, turning the vials suddenly, announced that the saint had performed the miracle, and instantly priests, people, choir, and organ burst forth into a great *Te Deum*, bells rang, and cannon roared; a procession was formed, and the shrine containing the saint's relics was carried through the streets, the people prostrating themselves on both sides of the way and throwing showers of rose leaves upon the shrine and upon the path before it. The contents of these precious vials are an interesting relic indeed, for they represent to us vividly that period when men who were willing to go to the stake for their religious opinions thought it not wrong to save the souls of their fellow-men by pious mendacity and sanctified fraud. To the scientific eye this miracle is very simple: the vials contain, no doubt, one of those mixtures fusing at low temperature which, while kept in its place within the cold stone walls of the church, remains solid, but upon being brought out into the hot, crowded chapel, and fondled by the warm hands of the priests, gradually softens and becomes liquid. It was curious to note, at the time above mentioned, that even the high functionaries representing the king looked at the miracle with awe; they evidently found "joy in believing," and one of them assured the writer that the only thing which *could* cause it was the direct exercise of miraculous power.

It may be reassuring to persons contemplating a visit to that beautiful capital in these days, that, while this miracle still goes on, it is no longer the only thing relied upon to preserve the public health. An unbelieving generation, especially taught by the recent horrors of the cholera, has thought it wise to supplement this power by the "Risanamento," begun mainly in 1885 and still going on. The drainage of the city has thus been greatly improved, the old wells closed, and pure water introduced from the mountains. Moreover, at the last outburst of cholera a few years since, a noble deed was done which, by its moral effect, exercised a widespread healing power. Upon hearing of this terrific outbreak of pestilence, King Humbert, though under the ban of the Church, broke from all the entreaties of his friends and family, went

directly into the plague-stricken city, and there, in the streets, public places, and hospitals, encouraged the living, comforted the sick and dying, and took means to prevent a further spread of the pestilence. To the credit of the Church it should also be said that the Cardinal Archbishop San Felice joined him in this.

Miracle for miracle, the effect of this visit of the king seems to have surpassed anything that St. Januarius could do, for it gave confidence and courage which very soon showed their effects in diminishing the number of deaths. It would certainly appear that in this matter the king was more directly under divine inspiration and guidance than was the Pope, for the fact that King Humbert went to Naples at the risk of his life, while Leo XIII remained in safety at the Vatican, impressed the Italian people in favor of the new *régime* and against the old as nothing else could have done.

In other parts of Italy the same progress is seen under the new Italian Government. Venice, Genoa, Leghorn, and especially Rome which under the sway of the popes was always scandalously filthy, are now among the cleanest cities in Europe. What the relics of St. Januarius, St. Anthony, and a multitude of local fetiches throughout Italy were for ages utterly unable to do, has been accomplished by the development of the simplest sanitary principles.

Spain shows much the same characteristics of a country where theological considerations have been all-controlling for centuries. Down to the interference of Napoleon with that kingdom, all sanitary efforts were looked upon as absurd if not impious. The most sober accounts of travelers in the Spanish Peninsula until a recent period are sometimes irresistibly comic in their pictures of peoples insisting on maintaining arrangements more filthy than any which would be permitted in an American backwoods camp, while taking enormous pains to stop the pestilence by bell-ringings, processions, and new dresses bestowed upon the local Madonna; yet here, too, a healthful skepticism has begun to work for good: the outbreaks of cholera in recent years have done some little to bring in better sanitary measures.*

* As to recourse to fetichism in Italy in time of plague, and the pictures showing the intercession of Januarius and other saints, I have relied on my own notes made at various visits to Naples. For the general subject, see Peter Études, Napolitaines, especially chapters v and vi. For detailed accounts of the liquefaction of St. Januarius's blood by eye-witnesses, one an eminent Catholic of the seventeenth century, and the other a distinguished Protestant of our own time, see Murray's Handbook for South Italy and Naples, description of the Cathedral of San Gennaro. For the incredible filthiness of the great cities of Spain, and the resistance of the people, down to a recent period, to the most ordinary regulations prompted by decency, see Bascome, History of Epidemic Pestilences, especially pp. 119, 120. See also Autobiography of D'Ewes, London, 1845, vol. ii, p. 446; also, for various citations, the second volume of Buckle, History of Civilization in England.

THE VALUE OF STATISTICS.

By Hon. CARROLL D. WRIGHT.

THE German historian Schlosser has said that history is statistics ever advancing, and statistics is stationary history. Looking beneath the words of Schlosser, one must conclude that he means that the constant accumulation of statistical data from period to period, or from epoch to epoch—that is, statistics ever in motion—creates history, history being made up of the ever-advancing events of life, which are shown through statistical methods, but that statistics of one epoch constitutes the permanent history thereof. The statistician, therefore, in the truest sense, writes history, and he writes it in the most crystallized form which can be adopted. He uses symbols, it is true, but with them he unlocks the facts of his period, so that they may be made plain to all students coming after him; he tells the story of our present state, that when the age we live in becomes the past, that story shall be found to exist in true and just proportions. The very word "statistics" indicates the soundness of the German writer's thought. The word is from the French *statistique*—from the Greek *statos*, meaning fixed, settled; *statos* being based on the stem *sta*, meaning to stand. Statistics, then, is used to illustrate fixed and settled conditions.

As a department of political science, statistics is used to classify, arrange, and discuss facts relating to a part or the whole of a country or people, or facts relating to classes of individuals or interests in different countries, and especially those facts which illustrate the physical, social, moral, intellectual, political, industrial, and economical condition or changes of condition of the people, in so far as such conditions may be indicated through numerical and tabular statements.

It is not a matter of much consequence whether statistics is a science or a method. English writers on statistics generally consider that it constitutes a method. Continental writers more generally insist upon its being denominated a science. The American opinion follows that of the Continent. It is true that statistical research can be called a scientific method of determining facts, and for studying various phenomena from which laws relating to life, production, distribution, consumption, etc., can be drawn; and the method must be considered scientific, because by it facts can be clearly stated, classified, and analyzed, elements which make science. We speak of the science of botany, because, for one reason, all the facts relating to botany can be classified; and so as to other departments of knowledge, classification or the lack of it determining the scientific or unscientific character of

the knowledge. Science demands a classification of facts so rigid that all men will consent to its integrity and to its use.

Whether statistics is a science or a scientific method, its use is sometimes empirical, deceptive, and illusory, and even dishonest; and because of these things the method is often condemned. We frequently hear it said that nothing is so uncertain as figures, and many writers contend that no thorough dependence can be placed upon statistical data. One long engaged in statistical work feels more and more keenly, as the results of original investigation, not only the limitations of statistics, but the fact that perfectly honest and truthful statistical tables may not only be vicious in themselves, but may also lead to the most worthless conclusions, the tables themselves not indicating, and it not being possible to fully indicate by them, the exact truth they contain. The method, I believe, is the surest for ascertaining conditions, and the truest on which to base conclusions; but the method must be supplemented by full and frank analysis. A statistical table, independent of such analysis, is to me what a red flag is to a bull. It immediately excites antagonism and invites attack. The value of any statistical presentation must depend upon the basis upon which it is made, the integrity of the collection of the various elements of it, and the analysis which accompanies it. No one has any right to quote statistical tables without using and understanding the analysis of them. It is because of the flippant and careless use of statistics by writers and speakers that it receives their condemnation. No one thinks, however, of condemning anæsthetics because the burglar chloroforms his victim; or the elementary rules of arithmetic, the means by which all honest accounts are kept, simply because dishonest accounts are made possible by the same means; yet I know that, because so many instances of the lying use of honest statistics meet one's observation, it is not remarkable that there are so many surprising denunciations of the method, and that we hear the oft-repeated statement that anything can be proved by statistics—a statement usually made for the purpose of belittling the importance and value of the method under discussion. It is perfectly true that one so disposed can, by dropping an essential element of a table, show the exact reverse of the truth, or, by a combination of truthful elements, prove an untruth; just as the foolish man thought he could prove by the Bible that there was no God, by quoting the exact language of the Psalms in the statement "There is no God," the whole statement being, "The fool hath said in his heart, There is no God." Such a use of statistics belongs to the theorist, who cares more for his idea than for the truth; who cares more for his view of the conditions of life than for the historical fact. Statistics is as dangerous in the hands of such a person as it is in the hands

of the statistical mechanic—the man who is ready at all times to construct tables showing such points as may be ordered of him. This latter person is a nuisance. He perverts facts and shows how to reach conclusions false in themselves by the use of truthful statements. Some practical illustrations drawn from actual experience may be of value, and show how we can guard against vicious conclusions when the statistical statements from which the conclusions are drawn are true. This method will also show the true value of statistics.

I have seen it argued that the production of cheese in the United States is growing smaller and smaller, and is likely to cease entirely. This argument is based upon the following figures, taken from the agricultural statistics of the Federal censuses of 1850, '60, '70, and '80: The production of cheese, according to such statistics, was, in 1850, 105,535,893 pounds; in 1860, 103,663,927 pounds; in 1870, 53,492,153 pounds; and in 1880, 27,272,489 pounds. Nothing could be more conclusive as evidence than these figures, because, while the statement for 1850 might be erroneous on account of imperfect enumeration, the enumerations have grown more and more complete; and if the 1880 figures show only about one quarter of the product of 1850, the cheese industry must soon cease to exist. A very little study and a very small amount of common knowledge would have taught the one using the argument I have quoted to examine the statistics of manufactures, as the production of cheese has been thrown largely into the factory. By consulting this side of the census, it is found that the production of cheese in factories in 1880 was 171,750,495 pounds; the truth being, therefore, that the production of cheese in the United States is, as one would naturally suppose, largely on the increase.

One of the most common statistical illustrations used in political arguments is that relating to the percentage of increase of population as compared with the percentage of increase in expenditures. I have prepared a little table (which I have never seen in print) showing the factors used in such an argument, supplemented by factors which ought to be used. The table is as follows:

Statement showing, decennially, the expenditures of the Government and the population of the United States from 1830 to 1890, inclusive, and the value of manufactured products in the United States from 1850 to 1880, inclusive, with the percentage of increase.

YEAR.	Expenditures.*	Per cent increase.	Per cent increase over 1830.	Population.	Per cent increase.	Per cent increase over 1830.	Value of manufactured products.	Per cent increase.	Per cent increase over 1850.
1830	$11,866,236 02	.....	.....	12,866,020	.....	.....	.....	.....	.....
1840	21,586,357 94	81·49	.....	17,069,453	33·52	.....	.....	.....	.....
1850	35,299,104 07	63·90	.....	23,191,876	35·88	.....	1,019,106,616	.....	.....
1860	58,955,952 89	67·01	.....	31,443,321	35·11	.....	1,885,861,676	85·42	.....
1870	136,081,304 98	130·82†	.....	38,558,371	22·63	.....	4,232,325,442	124·42	.....
1880	112,312,887 81	17·47†	218·17	50,155,783	30·08	116·26	5,369,579,191	26·87	426·80
1890	154,700,247 48	41·30	333·26	62,622,250	24·86	170·45	.....	.....	.....

* Expenditures on account of interest, pensions, premiums, and the principal of the public debt are not included.

† The marked increase in expenditures for the year 1870 over 1860 is largely due to the augmentation of the army and navy, caused by the civil war; and the decrease shown for 1880 is accounted for by the reductions made in the military and naval establishments.

Looking at one part of the foregoing table, it will be seen that between 1850 and 1890 the population increased 170·45 per cent, while the expenditures of the Government for the same period increased 338·36 per cent, the percentage of increase in expenditures being enormously in excess of the increase in population. If, however, one should examine the business side, which offers the truer basis of comparison, so far as expenditures are concerned, it will be seen that the percentage of increase in 1880 over 1850 was 426·89 per cent. The figures for 1890 are not yet available. Taking the same year, that is, 1880, for the three elements, we find that the population increased in 1880 as over 1850 116·26 per cent, expenditures for the same period 218·17 per cent, and the value of manufactured products increased 426·89 per cent. To carry this illustration to its logical completeness, the statistics of valuations and some others should be added, but they would simply be accumulative on the business side of the comparison as against the simple comparison of expenditures with population.

Criminal statistics are, perhaps, the most misleading, even when absolutely correct. The attempt is often made to compare the criminal statistics of one State with those of another, in order to determine relative criminal conditions. Such a comparison is and must be thoroughly vicious in every element. One illustration will be sufficient. Suppose one should undertake, as has been the case, to compare the criminal conditions of Massachusetts and Virginia by means of the statistics of crime. Such a comparison would lead only to unjust conclusions, to angry discussion, and to general ill-feeling, for the reason that the criminal codes of the two States differ widely. A few years ago I had occasion to examine this subject, and I found that the criminal code of Massachusetts, at the time the study was made, provided for the punishment of 158 offenses designated as crimes, and the sentences under the statutes of course appeared in the criminal statistics of Massachusetts. The code of Virginia at the same time recognized but 108 such offenses as crimes punishable at law; that is, there were 50 distinct offenses known to the Massachusetts law which were not to be found in the criminal laws of Virginia. No honest comparison, therefore, could be made between the criminal statistics of the two States, and a truthful statement of such statistics in comparison would lead to the most dishonest conclusions. Even with parallel codes and with accurate statistics of the number of persons in prison for crime, no conclusions would be justifiable, for of the offenses common to both States several were punishable by imprisonment in Massachusetts, but by fine only in Virginia. So the prison statistics would show sentences under grave crimes in Massachusetts, while the prison statistics of Virginia would show that no one had been sentenced for such crimes. The grave

offenses coming under this distinction are adultery, fornication, lewd conduct, drunkenness, carrying concealed weapons, extortion. From official returns made to the Secretary of the Commonwealth of Massachusetts from the various prisons for the year in which the previous study was made, it appeared that more than 54 per cent of the commitments were for crimes which in Virginia would have been punished by fine only, and the persons so punished never would have appeared, of course, in the prison statistics of the former State. Statistically speaking, then, the only comparisons that would approach fairness, under the conditions named, would be to reduce the actual number of prisoners confined for crimes in Massachusetts 33 per cent to conform to the number of crimes known to the two States in common. The balance, then, would have to be reduced 54 per cent on account of the crimes punishable in Massachusetts by imprisonment for which a fine only is imposed in Virginia. This illustration indicates how unwise it is to undertake to prove the moral or immoral condition of one community as compared with another by criminal statistics. The more accurate the statistics, the more unjust and vicious the comparison.

Another exceedingly effective illustration drawn from criminal statistics relates to some of the most perfect statistical showings I have ever had occasion to examine. From the year 1860 to 1879, inclusive, the criminal statistics of Massachusetts are perfect, and are the results of the certified reports of the clerks of all the criminal courts in the State. From the official statistics, as reported by the Massachusetts Bureau of Statistics of Labor in its Eleventh Annual Report, January, 1880, I have drawn certain comparative columns covering the crime of Massachusetts for the twenty years named. These columns are shown in the table on page 450.

What would a superficial examination of the foregoing figures, which, as I have said, are among the most accurate statistics I have ever examined, prove as to the progress of crime in the State named? I will use what I have seen or have known others to use, referring to these statistics. The increase in population in Massachusetts for the twenty years covered by the table was 50·4 per cent. The percentage of increase of crime for the same period was 70·4 per cent. If we look back to 1875, we shall find that the table shows that the population increased 34·1 per cent over 1860, and that for the same period crime increased 144 per cent, while in 1873 the increase of crime was 179·3 per cent. These figures, perfectly true and accurate, used deftly, give an exceedingly black eye to the State of Massachusetts, and no one can gainsay the bare statistical conclusion or attack the accuracy of the figures on which the conclusion is based. A very casual study of all the

Statement showing sentences in the State of Massachusetts for all classes of offenses, for drunkenness, including common drunkards, for crimes other than drunkenness and liquor offenses, and for high crimes, from 1860 to 1879 inclusive, with the annual per cent of decrease or increase since 1860.

YEAR.	POPULATION.		ALL CLASSES OF OFFENSES.		DRUNKENNESS, INCLUDING COMMON DRUNKARDS.		CRIMES OTHER THAN DRUNKENNESS AND LIQUOR OFFENSES.		HIGH CRIMES.	
	Total.	Per cent increase over 1860.	Total.	Per cent increase or decrease since 1860.	Total.	Per cent increase or decrease since 1860.	Total.	Per cent increase or decrease since 1860.	Total.	Per cent increase or decrease since 1860.
1860	1,231,066	....	16,513	.....	6,334	.....	9,385	.....	331	.....
1861	.....	....	14,294	13·4 dec.	4,426	30 1 dec.	9,339	5 dec.	382	.....
1862	.....	....	13,934	15·6 "	6,065	4·2 "	7,465	20·4 "	214	.....
1863	.....	....	14,850	10 "	7,066	11·5 inc.	7,347	21·7 "	162	.....
1864	.....	....	15,858	3·9 "	7,526	18·8 "	7,788	17 "	119	.....
1865	1,267,030	2·9	17,276	4·6 inc.	8,060	27 2 "	8,597	9·3 "	206	37·8 dec.
1866	.....	....	22,489	36·1 "	11,563	82·5 "	9,807	4·4 inc.	312	.....
1867	.....	....	26,281	59·1 "	11,019	74·1 "	11,588	23·4 "	275	.....
1868	.....	....	25,857	56·5 "	12,920	103·9 "	10,871	15·3 "	399	.....
1869	.....	....	31,850	93·1 "	16,742	164·3 "	12,160	29·5 "	317	.....
1870	1,457,351	18·3	39,693	140·3 "	18,880	198 "	13,310	41 9 "	394	19 inc.
1871	....	....	39,869	141·4 "	20,383	221·8 "	12,231	30·3 "	283	.....
1872	.....	....	45,297	174·3 "	23,587	272·3 "	13,498	43·9 "	310	.....
1873	.....	....	46,132	179·3 "	23,842	276 4 "	14,227	51·5 "	459	.....
1874	.....	....	43,684	164·5 "	22,748	259·1 "	14,506	54·5 "	455	.....
1875	1,651,912	34·1	40,404	144 "	23,553	271·8 "	14,613	55·8 "	590	51·1 inc.
1876	.....	....	38,108	100 "	18,107	185·8 "	13,805	47·4 "	490	.....
1877	.....	....	31,688	91·8 "	17,614	178 "	12,826	36·5 "	525	.....
1878	.....	....	31,118	88·4 "	16,795	165·1 "	13,340	42·1 "	626	.....
1879	1,852,586*	50·4	28,149	70·4 "	16,211	155·9 "	11,278	20·1 "	462	39·6 inc.

* Estimated.

facts, however, relieves the Commonwealth of the oft-repeated statement that crime is increasing much faster than population. The total number of sentences for all offenses for the twenty years is 578,348. An examination of the column of the foregoing table headed "Drunkenness, including common drunkards," shows that the percentage of increase since 1860 is 155·9 per cent, the total tal being 340,814; that is to say, 60 per cent of the total number of crimes reported under all classes of offenses belong entirely to what may be called "rum offenses." An examination of the statistics of crimes other than drunkenness and liquor offenses shows that the increase for the twenty years from 1860 to 1879, inclusive, was but 20·1 per cent, as against an increase of 50·4 per cent in the population. But the truest comparison is based on what are called "high crimes." These are the crimes which represent criminal conditions more than any other. They are the crimes of abortion, felonious assault, burglary, breaking and entering, burning a building, embezzlement, forgery, incest, murder, manslaughter, robbery, and rape. The total number of sentences under all these high crimes for the twenty years is shown in the foregoing table, with percentage of increase since 1860 brought into comparison with the increase of population. This increase in 1879 was 39·6 per cent over 1860, while the population for the same time had increased 50·4 per cent. This side of the table shows that any argument made to prove that the crime of the State of Massachusetts for the twenty years named increased much more rapidly

than the population is a vicious argument and the conclusion a false one.

The high crimes are those that have been always recognized as crimes. The crime of drunkenness and other crimes belonging to liquor legislation are modern, and in the light of this statement the table receives valuable explanation. In Massachusetts the prohibitory law of 1855 was in force until 1868, when a license law was passed. Under the former the vigorous prosecutions of 1866 and 1867 caused the number of sentences to increase rapidly, and this led to a repeal of the prohibitory law and the enactment of the license law of 1868. The friends of the license law insisted upon its vigorous enforcement, and this action carried the number of rum convictions of all grades still higher, when another reaction secured the re-enactment of the prohibitory law, which went into effect July 1, 1869, and under the application of this law the lines of figures representing drunkenness and liquor offenses went to their highest point in 1872. In 1870 the Legislature allowed the free sale of "ale, porter, strong beer, and lager beer," everywhere, unless prohibited by a vote of a city or town. This law was repealed in 1873. From the year 1873, either through the effect of the repeal of the beer law or of waning interest in the prohibitory law, resulting in decreased vigilance in prosecutions, the lines of figures dropped till 1875, when the prohibitory law was repealed. From 1876 to 1879, the last year named in the table, the figures constantly decreased.

It would be interesting in this respect to inquire whether the figures representing rum crimes are due to legislation wholly, or to vigorous or weak execution of law alternately applied, or to the positive decline of drunkenness through the efforts of reform movements. It is true that sentences for minor crimes and misdemeanors, and even felonious assaults and aggravated crimes, have risen or fallen, as indicated by the barometer of sentences for rum crimes alone. Legislative crimes—offenses which have been named crimes by legislative enactment—should not be used to show increase of crime in volume. Civilization has raised many things formerly considered as, perhaps, immoral and as offenses against the moral law to well-defined crimes. The result is, that we are constantly increasing the work of criminal courts; the number of sentences is thus increased comparatively, even when the volume of crime, as shown by the comparisons of crime *per se*, may decrease. So truthful statistics may show absolutely false conclusions, unless the elements are intelligently and honestly used.

Many illustrations as forcible as those cited might be drawn from the statistical work of the State and Federal Governments, but those given are sufficient to illustrate how dangerous truthful

statistics may be; and to show, further, that the value of statistics depends upon not only the integrity of their basis, but also on their intelligent and honest analysis.

Another line of fallacies comes from the misuse of averages. Mr. W. L. Sargant, in his Essays published in London in 1870, has an exceedingly interesting chapter entitled The Lies of Statistics, and I am indebted to him to some extent for an illustration as to averages. The frequent fallacies in the practice of striking averages add greatly to the disturbing influences resulting from inaccurate enumerations, the perplexity and differences in international trade accounts, the miscalculations by individual inquirers, and the inadequate consideration of all the elements of tabular statements. M. Quetelet explained the principle which ought to guide us in the matter of averages. He pointed out that an average may indicate two different things. For instance, if one measures Nelson's Monument ten times, and always with a slightly different result, and then adds the measurements together and divides the sum by ten, the quotient is an average or mean. So one may accurately measure the Duke of York's Pillar, the Parisian obelisk, and the Column Vendome, add the measurements together and divide the sum by three, and declare the quotient to be the average or mean height of these three monuments. M. Quetelet contended, and properly, that the results in the two instances are of such different significance as to require two separate names. He would limit the term "average or mean" to cases represented by the first illustration—the repeated measurement of one monument—and he would apply the term "arithmetical mean" to cases represented by the second illustration—the measurement of several monuments. The repeated measurement of one monument results in a mean approximation to something actually existing, and this is an excellent definition of an average. The measurements and calculations having reference to a number of monuments result in no knowledge of anything existing; they simply and only indicate a relation among things actually existing. It is through a misunderstanding of these elements that we have so many misleading statements of statistics relating to wages and prices. The development of wage statistics has kept pace with all statistical methods. The great trouble is that, on account of faulty presentations in the past, no very satisfactory comparisons of the present conditions with the past can be made; and, generally speaking, those who use statistical comparisons covering a period of years should be exceedingly careful that the elements are approximately identical for the various years of the period.

Statistical science improves like all others, and this improvement is doing much to lead empirical statisticians into erroneous

conclusions. The original faults of statistics are great enough, but the faults resulting from ignorant comparisons are greater still. On the whole, however, enormous as have been the errors, false as have been many of the statistical statements of official reports, inaccurate as have been many of the calculations, and fallacious and almost monstrous as have been many of the inferences, political economy has, nevertheless, profited greatly by what has been accomplished. The errors are gradually disappearing, and a very considerable remainder of truth has been left. We know far more than did our fathers of the progress of population, the resources of the nation, the earnings of the people, the cost of living, the efficiency of labor, more of criminal conditions, of mortality in town and country, of vagrancy and pauperism, of crowding and immigration; and, in fact, know more of all the conditions of life which make up sociology.* Legislators and philanthropists could ill spare their statistical guides, lame and delusive though they be, for "know thyself" applies to nations as well as to men, and that nation which neglects to study its own conditions and affairs in the most searching and critical manner must fall into retrogression. History is, indeed, statistics ever advancing, and statistics is stationary history. Science is best taught by examples of errors. This is to statistical art what a chapter of fallacies is to logic.

ACCORDING to Mr. T. W. Cowan, as quoted in Nature, who has written of the natural history, anatomy, and physiology of that insect, the bee can draw twenty times its own weight; its flight exceeds four miles an hour, and it will go four miles in search of food. Its wings, braced together in flight by a row of hooklets, bear it forward or backward, with upward, downward, or suddenly arrested course, by a beautiful mechanical adaptation which is described in the book. Its voice organs are threefold: the vibrating wings, the vibrating rings of the abdomen, and a true vocal apparatus in the breathing aperture or spiracle. The first two produce the buzz; while the hum—which is "surly, cheerful, or colloquially significant"—is due to the vocal membrane. Some of the bee's notes have been interpreted: "Huumm" is the cry of contentment; "Wuh nuh-nuh" glorifies the incessant accouchements of the queen; "Shu-u-u" is the frolic note of young bees at play; "Ssss" means the muster of a swarm; "Brrr" the slaughter or expulsion of the drones; and the "Tu-tu-tu" of the newly hatched young queen is answered by the "Qua-qua-qua" of the queens still imprisoned in their cells.

THE soundings of the Austrian vessel, the Pola, in the Mediterranean Sea, show that the water in the central basin of that sea is warmer, denser, and richer in salt than that of the western basin. As to transparency, a white disk was visible down to a depth of forty-three metres, but photographic plates were affected by light down to five hundred metres. No free carbonic acid was found in the water, and the amount of oxygen in solution was the same at the bottom as at the surface.

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* Compare Sargant's essay, The Lies of Statistics.

THE DEVELOPMENT OF AMERICAN INDUSTRIES SINCE COLUMBUS.

VII. THE EVOLUTION OF THE WOOLEN MANUFACTURE (*concluded*).

By S. N. DEXTER NORTH.

Fig. 26.—A Greek Spinner of To-day.

WE shall dwell but briefly upon the dyeing and finishing branches of the wool manufacture. In dyeing, the ancients attained a degree of perfection so remarkable as to recall the saying of the prophet that there is no new thing under the sun. They discovered and utilized vegetable and animal dyes of blue, purple, and scarlet, so brilliant and so delicate that, with all our knowledge and experience, we are not able to surpass them. The chief advance in this department of the manufacture has been in the greater ease with which dyeing is effected, and the consequent reduction in its cost, and in the increased number of tints and shades which can be imparted to the material. The art of dyeing appears to have been contemporaneous with the arts of spinning and weaving. Where these flourished, there the dyer always left behind him the evidences of his skill; when these languished and decayed, dyeing became one of the lost arts. The ancient Tyrians attained their celebrity as the most skillful dyers of antiquity by their use of the liquid of the shell-fish *buccinum* and *purpura*, while the early explorers of this continent were astonished at the brilliancy of the dyes which the Mexicans and the Peruvians extracted from forest trees. In the Peruvian department at the Philadelphia Exhibition there was exhibited a piece of woven cloth, taken from the tomb of the Incas, which had retained, for

more than two thousand years, its original colors scarcely dimmed. Modern dyeing must stand abashed in the presence of such evidence of a permanency it does not pretend to imitate. But it has made some wonderful advances, all within the last quarter of a century, in the successful application of the aniline dyes to fabrics; and the new combinations which are constantly evolved and applied, are all of them possessed of this great advantage, that they are brought within the reach of the millions.

Wool has an affinity for dye surpassing that of any other fiber, and there is no new discovery in dyeing material to which it does not instantly declare kinship. It is dyed to equal advantage either in the fleece (after scouring), the sliver, the yarn, or the piece, according to the use to which it is to be put. The dyeing department of a great wool-factory is one of the most critical points of its administration. Here again art touches manufacture closely. The designer and the dyer are the two agencies through which the manufacturer keeps in touch with the world.

The finishing of woolen goods is a series of operations no less important than those which have preceded, for they determine the final appearance of the textures. These processes are numerous and delicate. They have been vastly simplified and expedited by machinery, and chiefly in the last half-century. The most important of the finishing operations is that of fulling or milling. In this operation the cloth will lose by shrinkage from one quarter to one third of the length and breadth to which it is woven. The serrations of the wool, which have been left intact throughout the multitudinous manipulation to which the fiber has been subjected, fit into each other in the process of milling, and lock fast under pressure. Thus a piece of woolen cloth, originally a series of threads loosely woven, becomes apparently one solid mass, which can be pulled apart with difficulty. Fulling can only be accomplished when the

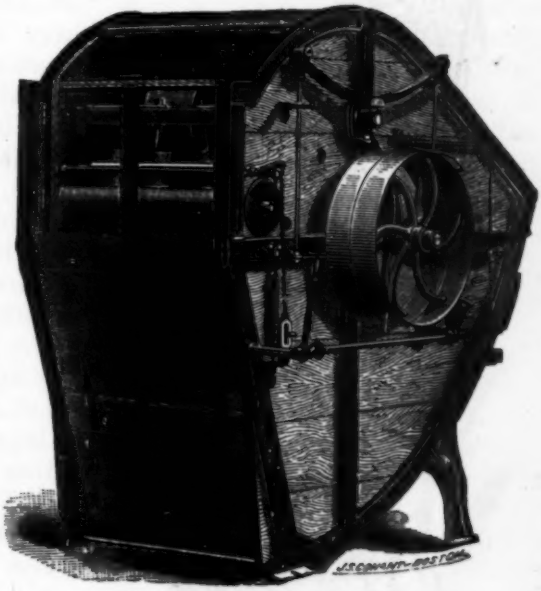


FIG. 27.—ROTARY FULLING-MILL.

cloth is damp, warm water and soaps being used to facilitate it. There appears to be no limit to the felting capacity of wool or the shrinkage which may accompany it.

By the most primitive methods the fulling was done in tubs under the pressure of the feet, a tedious process, requiring several days. In the early days of mechanical manufacture the cloths, after boiling or scouring to remove the oil, were folded in laps, hammered, refolded, and again hammered five or six times, until the fibers had matted and shrunk to the desired size. At a later period there followed a primitive method of automatic fulling, in a milling trough, with "stocks," which were two heavy wooden mallets, lifted in succession by cogs fixed on the axis of a water-wheel. These hammers would make from thirty to forty blows a minute, and the process was repeated four or five times, with intermediate soapings and rinsings, occupying a day to complete it.

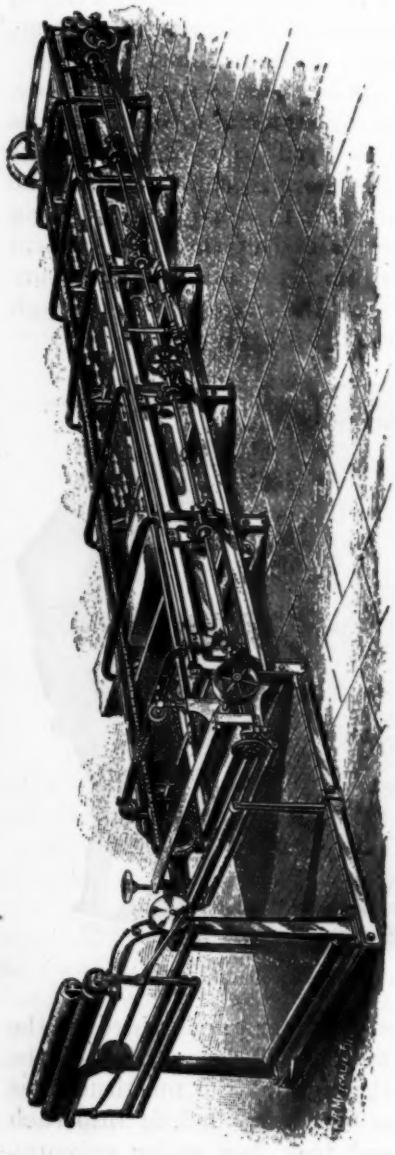


FIG. 23.—HOT-AIR DRYING AND TENTERING MACHINE.

The fulling-mill with rollers is an American invention, that of John Dyer, whose patent bears date 1833. The invention of the double crank-shaft fulling-mill was also of American origin, Levi Osborne's first machine, made in 1804, being the first of a series of valuable machines on that principle. By the use of the new methods of fulling, the cloth, after saturation with soap and water, is passed between two vertical rollers in a twisted condition, the pressure applied causing it to shrink in the direction of the weft. As the cloth passes through these rollers its progress is interrupted at intervals, and it is held in a trough

or case which causes the fabric to shrink in the direction of the warp. The first closed cylindrical fulling machine came into use about 1844. By its use this important branch of the work was executed with a precision and certainty hitherto unattainable, while much economy of room and saving of heat were effected by suppressing the old fulling machines.

After rinsing, tentering or dry stretching follows. In our older mill-yards may still be seen the tenter posts and hooks, upon which the cloth was stretched and left for several days to dry in the open air. This operation is now quickly performed by the use of revolving frames and steam coils. Raising follows, to open and disentangle the fibers, completely covering the surface of the goods after milling and tentering. The "nap" is raised by the use of the teasel, which earlier manufacturers set in a frame, having crossed handles, and scratched over the surface of the cloth. This frame formed a tool not unlike a curry-comb in appearance, and was used by two men, who scrubbed the face of the cloth as it hung in a vertical position from horizontal rails fixed to the ceiling of the workshop. The machine upon which this work is now done is called the raising-gig. It is a large cylinder, containing a number of iron rods closely set with teasels. It travels rapidly, in a direction opposite to the movement of the cloth, which, moving slowly, is brought in contact with the sharp and pliant teasels, which raise the fibers by a series of rollers, capable of adjustment according to the amount of nap it is desired to raise. The gigging machine also, while not originally an American invention, has received from Americans its most valuable features. As early as 1794 Walter Burt obtained in America a patent for a gigging-mill in which the rotating barrel was the distinguishing part; and the names of Jersey, Christie, Olney, Barrows, Beck, and Wells are honorably identified with its subsequent development.

FIG. 29.—HEAD OF FULLER'S TEASEL, AND HEADS OF WILD TEASEL.

The process of cutting off at an equal height all the filaments on the surface developed by napping was performed in the middle ages by the use of enormous scissors, and this method was contin-

ued, with but slight modifications, down even to the present century. It was slow, laborious, and extremely painful to the workmen who were compelled to operate the shears. The principle of the machine now used for shearing cloth is a cylinder armed with a knife arranged in a helix—a sharp screw turning tangentially in contact with a fixed knife and the cloth upon which the latter rests. Eleazar Hovey, of Canaan, Conn., patented a shearing machine in 1811; and this invention was introduced into France in 1812 by George Bass, of Boston, Mass., and there and everywhere is ranked among the most important of the inventions which have brought the woolen manufacture to its present high state.

Following the shearing, which fine cloths, like broadcloth, undergo twice and three times, are boiling and crabbing. Cloth that is to be "dyed in the piece" now takes its turn in the dye-house, and is run through the dye-kettles in an endless belt over cylinders, as in fulling. Crabbing is a process of scouring by steam, applied separately to each side of the cloth by rolling it upon large metal cylinders, and then rewinding the cloth, reversed, to give it the surface preparatory to dyeing. The process of inspection, called "perching," intervenes at one point or another, according to the fabric, by which any defects in the manufacture are noted. Knotters and burlers remedy these defects, removing knots left by the loom, and mending broken threads. Finally comes the pressing, by which the final finish and luster are given to fine cloths. Until quite recently pressing was done by folding the cloth in layers between boards of smooth pasteboard and pressing them between hot plates in hydraulic presses. A machine now expedites this process by compressing the cloth between rollers heated by steam. The inventor of the pressing machine with steam was Seth Hart, who received a United States patent in 1812. This invention appears twelve years later in Europe, John Jones taking out an English patent for the same machine in 1824. It appears that John Beverley, an owner of woolen and cotton factories in the United States, made the first use of the hydraulic press in 1803. He named it a "hydro-mechanical press." Bowker and Hall, of Boston, constructed a rotating cylinder press, heated by steam, in 1814, which is believed to have contained the first idea of the steam cylinder cloth-press now so universally used. The finishing operations to which worsteds are subjected differ slightly from those applied to woolens, with less of fulling and sometimes with none. Singeing machines are often utilized here, in which the fabric is passed over copper plates, heated to a white heat, so quickly and deftly as to burn from it only the excrescences, leaving the tissue itself unscorched and perfect. Thus completed, the goods are finally boxed and ready for the market.

Dr. Grothe, the distinguished German investigator of textile evolution, has testified that the contributions of American inventors to finishing machinery exceed in extent and value those of any other nation; and he adds that, as a result of his investigations, he is "happy to award the merit of priority in invention, frequently claimed for England, to America, the country which has created inventors through her system of home industry and personal liberty."

We have now completed our tour of the woolen-mill and our hasty examination of the machines which have superseded the earlier inventions in these establishments. Not less striking than their wonderful ingenuity is their multiplicity. We find not only a separate machine for each of the twenty-three different operations enumerated by Ure in 1834, but we also find, in the larger mills, great numbers of these separate machines. A modern factory is, therefore, something almost entirely different from anything which existed a century ago. It contains vast rooms, each devoted to separate branches of the industry. In one we find the scouring machines; in another, the carding machines; in another, if it be a worsted-mill, the combs and gilling machines; in another, long rows of whirling spindles tire the eye, and in another the clatter of hundreds of looms suggests pandemonium. Everything is systematized, and the surroundings of the operatives, with abundance of light, with perfect ventilation, with steam-heat, with convenient retiring-rooms, justify the statement that the gain of the manufacture through improved machinery is no greater than the gain of the operative, which has come through the accompanying improvement in the construction and arrangement of the buildings in which these operations are conducted.

The Wool Manufacture in the United States.

The development of the wool manufacture in the United States occupies a unique relation in this narrative. It is contemporaneous with the period of the actual mechanical florescence of the industry. Up to the time when our independence was asserted, we were a nation dependent upon our household industries and our foreign commerce. We used but little cotton—that little, strange as it now seems, being imported. Men and women were clad in homespun, spun and woven on the domestic wheel and loom. Almost every man was literally his own weaver. The earliest records show that the subject of their clothing was an object of solicitude to the primitive law-makers of the colonies. They were without any raw material whatever. They found no important fiber indigenous here, and their solicitude was great to domesticate sheep.

The first approach to a woolen-mill in the colonies of which

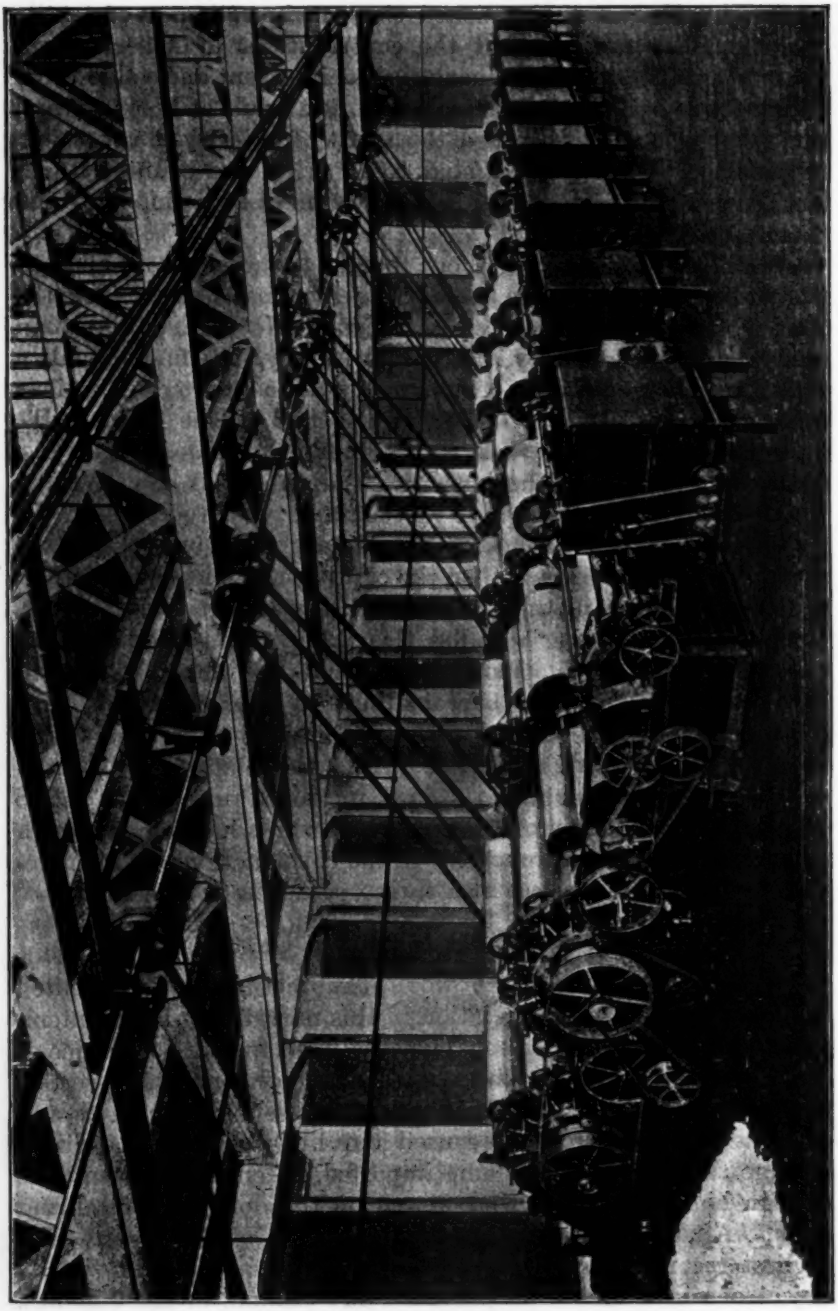


FIG. 30.—SECTION OF A WORSTED CARD-ROOM.

there is any record was a fulling-mill at Rowley, Mass., built in 1643, with gearing imported from England. Twenty or more families, trained in the cloth manufacture of Yorkshire, had settled in this town, and essayed to earn their livelihood by their

art. But the industry, there and elsewhere, was essentially of the home, and never went far beyond it, notwithstanding the pains which the General Court of Massachusetts took in 1656 to foster spinning by penalties. "Fearing that it will not be so easy to import clothes as it was in past years, thereby necessitating more home manufacture," the General Court ordered the selectmen in every town to turn the women, girls, and boys to spinning and weaving, each family to be assessed for one or more spinner, or fractional part, according to its size, and "that every one thus assessed do after this present year, 1656, spin for thirty weeks every year three pounds per week of linen, cotton, or wooling, and so proportionately for halfe or one quarter spinners, under the penalty of twelve shillings for every pound short." Legislation of this character shows how promptly the colonists recognized the advantage that must accrue to them from independence of the mother-country in their clothing supply. It also shows them apt pupils of the English system of stimulating special industries by patriarchal legislation. The stimulation thus effected was not without its results. The increasing production of home-made fabrics, while it still supplied hardly a twentieth of the needs of the colonists, nevertheless alarmed the home Government toward the close of the century. In 1699 a stringent decree was laid upon the movement of all woven fabrics within or without the plantations. The manufacture was not prohibited, but nothing was left undone to embarrass and check colonial enterprise in the pet British industry of wool manufacture. This prohibition extended to "wool, woolfells, shortlings, morlings, worsted, bay or woollen yarn, cloath, serge, bays, kerseys, says, frizes, druggets, shalloons, or any other drapery, stuffs, or woollen manufactures." This enumeration reveals something of the character of the goods the colonists were then making around their firesides, and of the names then applied to them.

Following the industry down through the eighteenth century, we find little or no modification of the primitive conditions indicated above. At the anniversary of the Boston Society for the Promotion of Industry and Frugality, August 8, 1753, three hundred "young female spinsters" spun at their wheels on the Common, and the movement for popularizing the home industry went so far as to be nicknamed "the spinning craze." In 1766 Governor Moore reported that there were two kinds of woolen made in the province of New York; "one coarse, of all wool, the other linsey-woolsey, of linen in the warp and wool in the weft." The Stamp Act troubles afforded a distinct stimulus to the industry, and appeals to patriotic pride in the weaving of home-made clothing were common. The president and first graduating class at Rhode Island College are immortalized in history by their ap-

pearance on the stage clothed in fabrics of domestic manufacture. Premiums were again offered to encourage both the growth of the raw materials and their manufacture. Ladies' meetings for patriotic spinning were inaugurated in various colonies, and these continued down to and into the Revolutionary War.

With the outbreak of that war, serious attempts at the manufacture of woolen goods in factories began. Samuel Wetherill was regularly engaged in the manufacture of woolen fabrics in Philadelphia about the beginning of the Revolution, and had a contract with the Provincial Congress to supply army clothing. In 1776 Edward Parker received three hundred pounds from the Maryland Legislature to assist him in the manufacture of woolen and linen goods. He had five looms. Charles Carroll, the signer of the Declaration, had a similar establishment. Neither of these parties, in all probability, used any power. The first mill in which power was used was the Hartford Woolen Manufactory, established in 1788 by a company of thirty-one gentlemen, most of them Hartford merchants. The factory was erected on a small stream, whose power operated two carding machines. For several years this factory achieved an annual output of five thousand yards of cassimeres and broadcloths, worth about five dollars a yard. An Englishman named Wansey, who visited this country in 1794 and inspected the mill, wrote that these cloths could be sold for about the same price as English goods, delivered in the stores at Hartford, "but the fabric was very poor and hard in the spinning, and dearer than the British, loaded with all the expense of freight, insurance, merchant's profits, and nine and a half cents duty." The Hartford company could not compete with the English cloth, even with these advantages, as its early collapse proved. While it lasted, it was quite the sensation of the country round about. General Washington's visit to the factory in 1789 is minutely recorded in his journal, and the patriotic spirit was stirred by the fact that he appeared at his first inaugural clad in a suit of broadcloth presented by the owners of the mill. General Washington noted the fact that "all the parts of the business are performed at the manufactory except the spinning—that is done by the country people, who are paid by the cut." It was to this factory that Hamilton alluded in his celebrated report on manufactures. Another woolen factory was established at Stockbridge in 1789, and another at Watertown in 1790. The three mills had a capacity of about 15,000 yards per annum, valued at $75,000. In contrast with these figures we have the official value of the woolens exported from England to the United States in 1799 at £2,803,490,* or more than two fifths of that country's total

* Bischoff, vol. i, p. 270.

woolen exports, no other country even approaching our own as a consumer of English woolens. No wonder Great Britain took drastic steps to preserve this splendid market.

Neither of these pioneer enterprises was a success, either mechanically or financially. The machinery was imperfect and inadequate, and the projectors learned by sad experience that they could not equal the British fabrics either in quality or in price. The Hartford factory struggled along until 1795, when the machinery—consisting of eight looms, two carding machines, one spinning jenny, one twisting machine, and other odd implements—was sold at auction.

The year before the collapse of the Hartford factory the first incorporated woolen company in the United States began operations at Byfield, Mass. The Byfield factory was operated for five years under the superintendence of John and Arthur Scholfield, two ingenious Englishmen, who are commonly spoken of as the first woolen manufacturers in the United States, in the same sense that Samuel Slater is described as the pioneer cotton manufacturer. It is certain that theirs was the first instance of a successful woolen manufactory with improved machinery of a character which entitled it to rank with the mills which were plentiful in Great Britain at the date of which we are speaking. The Scholfields introduced a new carding machine, of their own construction, based upon the machines they had seen in operation in their native land. It was adapted to water-power, and the beginning of the new era of woolen manufacture in the United States fairly dates from it.

For many years prior it was vaguely realized in the United States that the world was upon the eve of a new and strange industrial development, from participation in which this country seemed to be excluded by laws designed to keep it industrially dependent. Tench Coxe states that he first became aware in 1786 that labor-saving machinery for spinning was being largely used in Great Britain, and he then made unsuccessful efforts to obtain models of these machines. The mother-country, thoroughly awake by this time to the significance of the textile inventions of her citizens, had passed laws by which she hoped to retain the monopoly of the rich harvest their ingenuity promised. The first of these statutes, enacted in 1774, a few years after Arkwright's successful inauguration of the factory system with his new appliances, was entitled "an act to prevent the exportation to foreign parts of the utensils made use of in the cotton, linen, woolen, and silk manufactures of this kingdom"; and its purpose, as set forth in the preamble, was "to preserve as much as possible to his Majesty's British subjects the benefits arising from these great and valuable branches of trade and commerce." The statute pro-

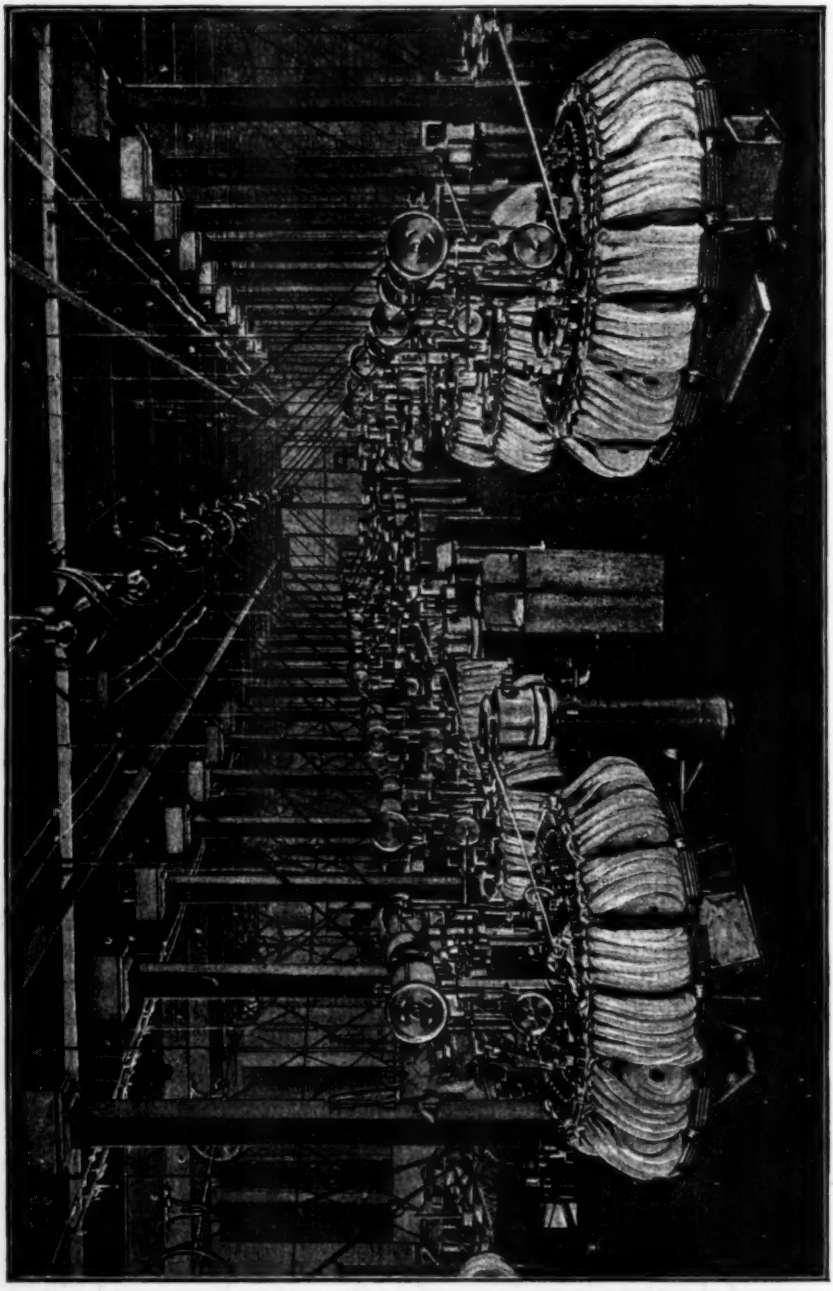


FIG. 31.—A COMBING-ROOM.

hibited, under penalties of forfeiture and heavy fines, "the putting on board of any ship or vessel, not bound to some port or place in Great Britain or Ireland, of any tools or utensils commonly used or proper for the preparation, working up, or finishing of the cot-

ton, woolen, silk, or linen manufacture." Another statute, even more stringent, was enacted in 1781, by which a year's imprisonment was added to the penalties of forfeiture and the fine of £200 previously imposed. This policy was rigorously enforced, notwithstanding some modifications of the law in 1825, and again in 1833, until the year 1845, when machinery for the textile manufactures was for the first time omitted from the list of prohibited exports.

No known instance occurred during the earlier decades of the enforcement of these laws in which a perfect textile machine was smuggled into this country. Some few models were clandestinely introduced, but they were of so imperfect a character that it may literally be said that the United States was compelled to invent anew the machinery with which, gradually, and after a most trying probation, her textile industries were finally established. The more remarkable is it, therefore, that this country learned so quickly how to clothe itself, and maintained and developed a great woolen industry in the face of a nation which had such a tremendous start in the race.

No circumstances could have afforded a greater incentive to the inventive faculty of a young and ambitious people. Very soon it was at work; very rapidly it traversed the ground already covered in England; and very naturally it has happened that the inventors of the United States have supplied the world with many of the most important of the inventions which have accelerated the development of the textile arts.

For many years the carding machines formed an important part of the fulling-mills of the clothiers of the early part of the century. As late as 1810 the trade of the clothier was as distinct as that of the hatter, although both have nearly disappeared. In New England nearly every township had its carding and fulling mill, the machinery being moved by power. The wool was carded into rolls, to be spun in the household, at a cost of about seven cents a pound, and the cloth, after having been woven in the families, was fulled and dressed by the clothier.* In Vermont, in

* This was not always the case, however. Judge Johnston, of Cincinnati, in his address before the Pioneer Society of that city in 1870, gives the following graphic picture of a method of home-fulling which, he says, prevailed throughout Ohio early in the century: "When the wool became abundant the method of scouring and fulling blankets, flannels, cassinets, and even cloths, was simple. Every house had hand-cards, and as many spinning-wheels as spinners, and no respectable house was without a loom. When the goods were carded, spun, and woven, then came the kicking frolic. Half a dozen young men and as many young women [to make the balance true] were invited. The floor was cleared for action, and in the middle was a circle of six stout splint-bottom chairs, connected by a cord to prevent recoil. On these sat six young men with shoes and stockings off and trousers rolled above the knee. In the center the goods were placed, wetted with warm soap-suds, and then the kicking commenced by measured steps, driving the bundle of goods

1810, 1,040,000 yards of cloth and flannel were woven in families and dressed in these mills. In 1840 there were 2,585 fulling and carding mills in the United States. Forty years later this number had been reduced to 991; and, in the decade since 1880, the mortality among them has been even greater. In the mills which still remain, on the outskirts of civilization, the operation of fulling has been almost wholly abandoned, and custom-carding only is done for the neighbors who still spin and weave their homespun.

Of the early stages of the introduction of wool-spinning machinery in this country the records are exceedingly deficient. Spinning jennies, built by Arthur Scholfield as early as 1806, were the first actually utilized in this country, and are described as containing from twenty to thirty spindles, upon which a single woman could spin from twenty to thirty runs of fine yarn a day "in the best manner."* These jennies cost about fifty dollars' and were operated by a crank moved by hand. In the history of the oldest woolen manufactory in Rhode Island, the Peace Dale Company, founded by Rowland Hazard in 1802, spinning and weaving were carried on wholly by hand, until about 1819, when a spinning jack of fifty-two spindles was operated.†

The power-loom for weaving broad goods was not introduced until 1828. The date of 1830 has been fixed upon by Dr. Hayes as marking the successful introduction of the woolen manufacture in this country substantially with the principal appli-

round and round; the elderly lady, with long-neck gourd, pouring on more soap-suds, and every now and then, with spectacles on nose and yard-stick in hand, measuring the goods till they were shrunk to the desired length. Then the lassies stripped their arms above the elbows, rinsed and wrung out the blankets and flannels, and hung them on the garden-fence to dry."

* The Philadelphia Magazine or American Monthly Museum for 1775 describes and illustrates what it calls "the first spinning jenny introduced in this country" and made by Christopher Tully in that year. The editor says of it: "The machine for spinning twenty-four threads of cotton or wool at one time (by one person) having attracted the notice of the public, and we being desirous to contribute everything in our power toward the improvement of America, engaged Christopher Tully, the maker of the machine, to furnish us with an engraved plate and description thereof. . . . We have seen the machine perform and are convinced of its usefulness. The Society for the Improvement of Arts, Manufactures, and Commerce in England repeatedly offered a premium of £100 sterling for a machine on this plan, but never had any presented to them which would answer the purpose. Notwithstanding which a very large one has been erected at Nottingham, in England, which performs to great advantage, but no person as a speculatist is admitted to see it."

† Mr. Hazard has shown the progress of thirty years in the following statement: "In 1816 and later I used to employ scores of women to spin at their homes at four cents a skein, by which they earned twelve cents a day at most. The wool was carded into rolls at Peace Dale and transported to and from on the backs of horses. Some time ago I stood in a manufactory in the same village and took note of a stripling who tended two highly improved jennies, from which he was turning off daily as much yarn as six or seven hundred formerly spun off wheels in the same time."

ances and machinery of the present day. This was the date of the erection of the Middlesex Mills, of Lowell, of whose history it has been written that "it covers the entire life of the successful woolen industry of this country." In the earlier days of our manufacture, the products of our mills were chiefly the coarser fabrics. Until about 1840 they consisted almost wholly of satinets, flannels, and blankets. The manufacture of fine broad cloth was indeed early attempted, and with considerable success. Gradually, amid many vicissitudes, and with great loss of capital, large mills were established and succeeded in maintaining themselves and in diversifying the industry.

We shall not attempt to state the statistics of this development. They are accessible in the census reports to those specially interested. By 1880 the product of all our mills, employed in the manipulation of wool in any form, was stated at $267,000,000, and the census of 1890 will show this product not far, if any, short of $350,000,000. Next to England the United States is to-day the largest wool manufacturing nation, and the people of the United States consume a much larger quantity of wool per capita than any other people. Indeed, the increasing capacity of our woolen-mills barely keeps pace with the increasing consumption of our people.

Economic Aspects of the Evolution.

The evolution of the wool manufacture has had an economic influence upon civilization more marked even than that which has to do with the cost of clothing. Indeed it is a disturbing element, in estimating this reduced cost, because that which was once fabricated at home, by the members of the family, the labor of some of whom at least would otherwise have counted for nothing, is now bought in the shops. This evolution has substituted the factory system for the household industry, almost obliterating the latter in all countries which are within reach of commerce. We have seen how important an element in the household economy of the American colonies and the early republic the making of the cloths for clothing was. It was of even greater importance in England and France, and particularly in England, where, up to the introduction of automatic machinery, the handling of wool, both for domestic use and export, continued to be the most important occupation of the people next to agriculture, with which it was so closely allied. We can trace the gradual development of the old English system into the new. The founders of the great houses which now conduct the industry were, many of them, the hand combers or spinners or weavers of the primitive industry. They were the forehanded among these laborers, who gradually took others into their employment, and, as machinery came into vogue, were able to utilize it. Thus the minute subdivision of the house-

hold industry has been duplicated in the English factory system. The scouring of the wool is done by one establishment, the carding and combing by another, the spinning by another, the

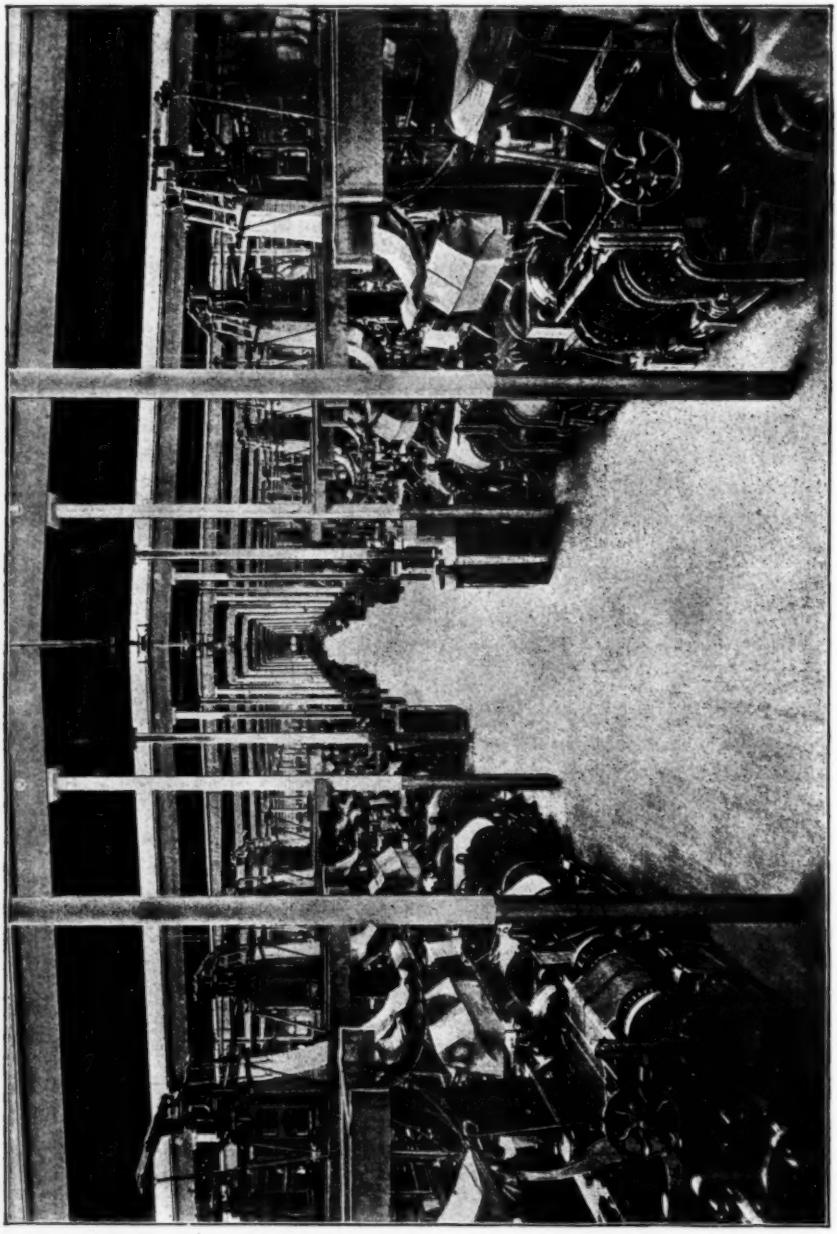


FIG. 32.—A WEAVE-ROOM.

weaving by another, the dyeing and the finishing by still others; while the packing of the goods for the market often con-

stitutes still another distinct subdivision of the business. While this minute subdivision of the industry is largely the outgrowth of conditions rather than a tendency evolved from experience, it may be said to be definitely determined that the best results are attained by it. Under this system a community like Bradford in England is a great beehive of interdependent industries, the separate stages of the manufacture being carried on in separate establishments. The whole energy of the management, in each branch, is devoted to securing the best results in that particular branch under the most economical conditions. Here, in a radius of 75,000 acres, with a population of 500,000 people, is consumed nearly or quite one half of the total quantity of wool worked up in Great Britain. Here a capital of £40,000,000, employing 140,000 operatives, turns out each year a product of manufactured wool valued at nearly the total amount of its capital. Here, built up within the century, is an aggregation of organized industrial development without a parallel among the princely cities of antiquity—the most striking, the most tangible, of the many results of the evolution of the wool manufacture. The complete organization of the Bradford manufacture indicates the ultimate development of the industry.

It is not difficult to understand why the development of Great Britain and France, in this particular, with its striking concentration of the textile industries in towns like Bradford, Huddlesfield, Manchester, and Leeds, and Rheims and Roubaix, has not been duplicated in the United States. While the factory system here has superseded a household industry, it is in no sense an outgrowth from it. We have seen why not, in the difficulties which attended the procurement of machinery in the early days of manufacture here. The first factories were stock companies, necessarily, for few individuals had the capital necessary to found mills. These original mills performed all the operations of the manufacture, because there were no agencies through which any part of these operations could be independently carried on. Waterpower being then the great desideratum, they were widely scattered on the streams of the New England and Middle States. This scattering created the necessity for the equipment of complete mills under one management. Time is gradually effecting something of a concentration of kindred industries, as in Philadelphia, which is called the textile center of the United States, and in New England towns like Fall River, Lawrence, and Lowell. With this concentration, there is gradually evolving a system of subdivision. This tendency we may look to see increase in the wool manufacture, with a corresponding gain in the stability of the industry, and in the variety and the excellence of its products.

Surveying the whole field, we are struck by two features in

this evolution, the combination of which includes the sum of the advance. Not less wonderful than the succession of power-machines for the automatic handling of the fiber in the several stages of its manipulation, is the series of mechanical contrivances for the automatic delivery of the material from machine to machine without the touching of human hand. The ingenuity of man has been constantly directed, in these latter years, to devices for the accomplishment of two purposes: first, to increase production; second, to diminish waste. Both tend to reduce the cost to the consumer, the first by reducing the number of operatives required to make a given amount of product and by increasing the productive capacity of machines otherwise perfect. Perfect as these machines now appear to be in their operation, every one among them is susceptible of improvement, and the patent offices of every manufacturing nation are burdened with the plans and specifications of new devices, conceived by the bright mechanics who abound among the operatives, and suggested generally by their daily work and observation, the purpose of which is to add either simplicity or celerity, or to still further reduce the necessity for handling.* Most of these inventions come to naught; many of them are constantly introduced into the mills. Some few of these advances not previously spoken of may be enumerated here. Self-feeders on the first breaker and finisher have been applied to card machines, dispensing with half the help formerly necessary in the card-room. Self-operating mules have been introduced in cloth-mills, effecting a saving of from twenty to forty per cent in the cost of spinning. Improved winders, driers, and cloth-presses give greatly increased rapidity to the processes of finishing. In weaving flannels, a width of three yards at once, seventy-five or eighty picks a minute are woven as economically and as excellently as forty or fifty picks were thirty years ago. In making cassimeres, the broad loom has been generally substituted for the narrow loom almost universally employed as recently as 1860. Fifty-six yards of Brussels carpet can now be woven in a day by one girl, in the improved looms, where fourteen yards a day was a good product in 1860, with the same help. Similar illustrations might be multiplied almost indefinitely. While there has been no new departure or novel idea of transforming effect in the wool manufacture, the general advance in mechanical efficiency, during the last quarter-century, has been so great as to equal an economical gain in manufacture equivalent to that which took place when power was first substituted for hand-labor. In our great yarn-

* The records of the United States Patent Office, from its founding up to July, 1890, show a total of 8,890 patents issued for textile machinery, divided as follows: Felting and hat-making, 1,231; carding, 1,194; knitting, 1,189; spinning, 1,921; weaving, 2,954; cloth-finishing, 401.

mills there is constant progress in the direction of an increased product, of a finer quality, from the same machinery. The standard of productive capacity is thus shown to be variable, dependent in a perceptible degree upon the ability of the management to get the best results from a given capacity. The obvious advance in the future is in this direction. We can hardly look for any radical new departure in the mechanism of wool manufacture, such as occurred with the introduction of automatic spinning, the combing machine, and the power-loom. At the same time it would be foolish to assert that some new mechanical discovery, which may be at this very moment lying fallow in the brain of an unknown genius, will not work another revolution as complete as that which marks the transition from the household to the factory system. We can not, for instance, doubt that electricity is to work its wonders in this department of human industry as well as in every other.

This paper may properly conclude with some indication of the nature of the world's gain from the evolution of the wool manufacture. It is difficult to obtain a proper standard for such comparison. Statistics, even were they obtainable, present the contrast very inadequately. The total gain secured over hand-labor can hardly be estimated at an absolute value, for the present efficiency can not be obtained. In the principal operations of the manufacture the increase has been about as follows: In olden times a woman could card one pound of wool a day by hand. At present one operative, with the necessary machinery, can card one hundred to one hundred and fifty pounds a day. Hence the improvement is about one hundred and twenty-five. On a spinning-wheel a woman could produce daily two skeins. An average mule to-day spins about five hundred pounds; hence the improvement is about five hundred times. On a hand-loom it took a day to weave two to three yards. Power-looms produce from thirty-five to fifty yards a day, or an improvement of seventeen. Hence, disregarding all other factors but these, and placing a modest estimate, it is possible at present, with power machinery, to produce over seven hundred times more goods to-day than in the olden time, with the same number of hands, disregarding the quality, design, etc. This enormous gain can hardly be stated by periods. It has practically been achieved in a single century. In 1800 it was declared in the British Parliament that thirty-five persons could then accomplish, in the wool manufacture, with the aid of machinery, what would have required the labor of sixteen hundred and forty persons in 1785. That was equivalent to the statement that one person could then do the same work that forty-seven had done fifteen years earlier.

We have already alluded to the last half of the eighteenth

century as marking a greater advance in the textile industries than all the centuries preceding it. The range of improvement in the present century covers the whole ground of the evolution, except the bare principle of automatic or mechanical manufacture, which was still in its infancy in 1800. The nineteenth, therefore, outranks even the eighteenth century in the economic progress which distinguishes it. Of this tremendous advance the most important steps, so far as relate to machinery for expediting processes, economizing help, and performing complicated operations automatically, have occurred in the latter half of the present century.

The individual capacity of the operative, thus enormously increased by machinery, has been accompanied by an increase in the total number of persons solely occupied in the manufacture of wool. The number who were thus employed in the period of household industry can not, of course, be estimated. But a vastly larger number of persons now depend directly and solely for their livelihood upon employment in woolen-factories than was ever the case before the introduction of power machinery and the factory system, and they are able to earn quite double the wages of the hand-operative of olden times.* It follows that the increase in

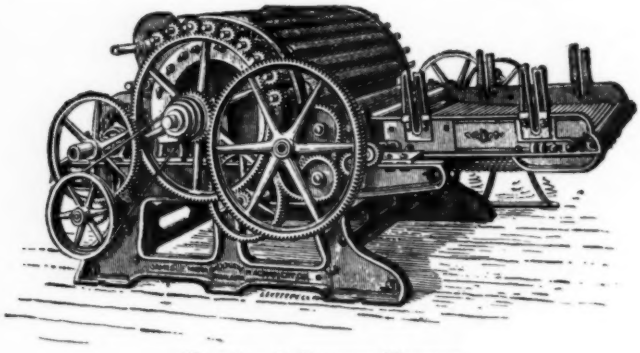


FIG. 33.—A GARNETT MACHINE.

the production of woolen goods to-day is very much greater than would be indicated by the fact that the labor of one operative is now equivalent to that of one hundred operatives one hundred and fifty years ago. This deduction is borne out by the extraordinary increase in the world's wool-clip. It is safe to put the annual product of wool at 2,000,000,000 pounds in the greasy state. Of this amount nearly one half comes from three countries—Australia, South America, and South Africa—whose wool-clip is a

* The hand-loom weaver in the United States never earned more than fifty cents a day, and in earning it he was compelled to exert himself physically to a degree not approximated in the management of a power-loom.—CARROLL D. WRIGHT.

development subsequent to, and undoubtedly caused by, the substitution of machine for hand manufacture. The clip of the United States has increased from a few hundred thousand pounds, at the time of the Revolution, to over 300,000,000 pounds, and the product of the continental countries has also increased very greatly in the interval.

To fully realize the quantity of raw material now consumed in what are commonly known as woolen goods, we must estimate the quantity of waste and substitutes utilized as equal to that of wool; and thus we have 4,000,000,000 pounds of raw material passing annually through the looms of the world. Hand manufacture knew no such thing as a substitute for wool. The raw material has only been kept abreast of the manufacturing capacity by the discovery of methods for the utilization of these substitutes.

Something of what the world has gained in quantity has been lost in quality at certain points. It can not be pretended that the utilization of wastes and substitutes does not involve a certain element of deterioration. Nevertheless it is a distinct gain to the world, as is every new development that reduces the waste in any branch of industry. Within a few years a machine has been invented, known as the Garnett machine, which enables manufacturers to comb out all their waste, whether from cards, mules, spinning-frames, or from whatever source tangled and twisted fibers are produced in the various processes of manufacture, and to so restore it that it may be again utilized in connection with the original fiber. The saving thus effected is enormous. The machine, as the illustration shows, is in principle the same as the carding-engine. Its strong, sharp-pointed, steel teeth gradually untwist and teasel out the kink in yarn or thread, restoring the fibers of wool in nearly their original length of staple.

The fiber of wool has a wonderful capacity of endurance. Once used it may be, and is, used again and again, reproduced, not with all its original virtues, but still with many serviceable qualities, and called, according to its form, shoddy, mungo, waste, wool-extract. The French, by a happy conceit, call this material *renaissance;* and it is literally wool born again. By chemical processes the wool in mixed goods is separated from the cotton or other fibers employed for its adulteration, and wonderful machines tear it apart, readjust its fibers, and prepare it again for the spindles. Thus it goes into new garments, of a cheap grade, to be sure, but, if properly prepared, of a serviceable quality. It is customary to speak contemptuously of shoddy and of those engaged in its manufacture and use. But those who do so do not understand how important is the part now played by this preparation in the cheapening of the people's clothing and in the well-dressed appearance of the community. Goods into which this material

enters, or goods in which the warp is made of cotton, have not the enduring quality of the fabrics woven by our ancestors. President Eliot, of Harvard University, in a recent magazine contribution, says: "The Hessian country girl proudly wears her grandmother's woolen petticoats, and they are as good and as handsome as sixty years ago. A Scotch shepherd's all-wool plaid withstands the wind and rain for a lifetime"; and he adds a eulogy of the old Swiss porter's overcoat, which had kept him warm and dry for twenty-five years. In sharp contrast with these examples the learned college president speaks contemptuously of the "all-cotton" clothing of an American rural community that costs about ten dollars a suit, fades promptly, and wears out at the slightest provocation. If President Eliot desired his readers to infer that the farmers and peasants of the foreign countries which he names are better clothed than our own farmer classes, he unconsciously permitted himself too broad a generalization from the interesting and isolated instances which he cites. The machine-made cloths of this day and generation do not last a lifetime, or sixty years, or even twenty-five years, either in the United States or in Europe. The fabrics which so excited his admiration were the homespun products of hand manufacture. It is true that they had great endurance, and this quality they secured at the sacrifice of lightness and compactness. Heavy cloths of the homespun characteristics are not now made by machinery, because the people prefer lighter fabrics, even though they wear out quickly. They are able to gratify their preference because the evolution has reduced the cost of everything in the nature of wearing apparel to a degree only less striking than the increased productive capacity. It is equally difficult to express this gain in figures. But it is indicated by the fact that the farmer's wife can afford to abandon the spinning-wheel and loom and purchase the finished product of the fleece which she sends to market rather than to transform it herself into the long-lived goods which President Eliot so greatly admires.

How vaguely do the people realize the thousand-and-one comforts and conveniences and economies which have been brought into every household by the cheapening of fabrics of almost infinite variety of form and utility which the woolen manufacture has taken on! There is now no phase or form of want, of garment, of decoration, or of household economy, which can not be gratified at a reasonable cost.

The variety of the fabrics into which wool is now converted is one of the most striking features of the evolution. The carpets on our floors, the blankets that cover both our horses and ourselves, the reps and plushes that make the most durable and elegant coverings for household furniture, railroad cars, etc., the

curtains that shade our windows and form the drapery of our doors and parlors, the stockings on our feet and the mittens on our hands, the knitted underwear that guards us from *la grippe*, the dresses in which our wives and mothers do their shopping, the clothes that we wear, the overcoatings and even the overshoes necessitated by our inclement winters, the bunting that we display on the house-tops on the national holidays—everywhere we utilize wool, and the more of the wool and the less of cotton, silk, linen, or other fibers used in all these ways, the warmer, the healthier, the more endurable, the more satisfactory is the result.

It would be interesting, had we not already far outstripped the bounds of a magazine article, to follow the manufacture into these subordinate branches, which are more numerous than in any other industry, and several of which, particularly the manufacture of carpets and of knit goods, present unique phases of development which have not even been hinted at in these pages. Enough has been said to show that the ancient myth of the golden fleece was prophetic of an industry which has added fabulous wealth to the world, and which will continue to supply increasing employment to labor and increasing employment to capital through all time to come.

HYPOCRISY AS A SOCIAL DEBASER.

By Dr. R. W. CONANT.

IT is difficult to decide whether the author of Hypocrisy as a Social Elevator is to be taken seriously. That a thoughtful and conscientious man who knows the meaning of hypocrisy could seriously advocate a doctrine so Machiavellian is the worst horn of a dilemma, and it seems more likely that he is simply trying to "raise a breeze." Indeed, this would be rather implied by his final statement, that he "calmly awaits the vehement chorus of dissent from this proposition."

Hypocrisy is, indeed, an indisputable fact, ancient as Adam and Cain and world-wide; but any claim that this detestable tendency of human nature is a social elevator requires a reply, if only because some persons rather weak on their moral and intellectual pins, particularly among the young, might take these sophistries seriously, to their own great loss and detriment.

In the first place, our advocate of hypocrisy seems unaware of the meaning of the word. It is from the Greek, "to question and answer," as actors on the stage; hence, to play a part, and especially to pretend to be better than one is in virtue or religion. What has this in common with the abstinence which Hamlet recommends to his mother in the extract which Mr. McElroy

quotes? Nothing. Abstinence tends toward virtue, hypocrisy toward vice. But this is a minor matter, since Hamlet is scarcely a safe social guide.

A like confusion of ideas arises when he quotes these words, which he appears to fancy contain an element of hypocrisy:

> ". . . rise to higher things,
> With their dead selves as stepping-stones."

Tennyson's arrangement is better, but that is an error in taste. It is a more serious error to confound hypocrisy with the grandest attribute of man, the power to set his feet on his dead sins and rise toward the Throne. Not so hypocrisy. It hugs its sin in secret and sneaks toward hell. Better any day the bold sinner than the hypocrite.

Congratulations are in order for the Pharisees. They have at last found an apologist, perhaps an admirer; rather late, to be sure, but better late than never. It seems that "they were powerful promoters of the ethical development of the Jews," etc. There must be a big mistake somewhere, for it was said of them by one who surely had better opportunities for observing and knowing the Pharisees than Mr. McElroy, "O generation of vipers, who hath warned you to flee from the wrath to come?" "Woe unto you, scribes and Pharisees, hypocrites! for ye devour widows' houses, and for a pretense make long prayer; therefore ye shall receive the greater damnation." Rather a harsh way to address "powerful promoters of ethical development"!

But the excellence of the Pharisees is hardly a subject for serious consideration, and we hasten on to those portions of the argument which have some plausibility, viz., the cases of patriotism, women, and religion. The key-note of this hymn to hypocrisy is struck in the remark on the second page, "No man is worse by simulating goodness." This may sound finely epigrammatic, but unfortunately there is not a word of truth in it. Any one is *always* worse by simulating goodness, for that means assuming the appearance of it without the reality. Not only is he no more virtuous than before, but his vice has acquired an additional sneaking quality, which makes the man more contemptible *per se*, and infinitely more dangerous to the community. Imitation is the tribute which vice pays to virtue, doubtless, but the vice is none the less vicious.

In the case of patriotism it is doubtless true that exaggerated statements of the virtues and greatness of the past do little harm and often good, but it is rather far-fetched to endeavor to class such exaggerations as hypocrisy. The hypocrite is not anxious to exalt others, but himself; even if, in exalting himself, he pulls down others. But, waiving this confusion of terms, does any one

suppose that myth is more elevating to a people than sober historical fact? If it were true, we had better find some way of suppressing future Grotes, Bancrofts, and Motleys.

As to the elevation of women, it might seem at first blush that Mr. McElroy was hardly serious in his theory that the young woman who asked her mother if she should "wash for a high-neck or low-neck dress" might in time, by the practice of such hypocrisy, rise to the virtue of a full-length bath! But seriously, is there any one who can regard such dirty hypocrisy as "a social elevator"? "He that is filthy let him be filthy still."

"Nothing aided the elevation of women so much as the arrant hypocrisy which took the form of mediæval gallantry. . . . At first hollow and specious to the last degree—thinly varnishing a bestiality so low that it was scarcely above that of a bull seal," etc. Here our apologist makes a point worthy of consideration. It can not be denied that gallantry, even exaggerated and underlaid by bestiality, is far better than boorishness; but to say that it is a social elevator involves a fallacy, very prevalent, to be sure, but none the less a fallacy—viz., the idea that fine manners make fine people. It is generally supposed, and sometimes preached, that manners, culture, education, music, what not, elevate society. Here lies the essential fallacy of this whole article and of all similar screeds—a confounding of *post hoc* with *propter hoc;* a putting of the cart before the horse. What is it to "elevate society"? To impart expertness in playing the piano, in making bright repartees, giving and attending dinners elegantly, dancing gracefully, or even being conversant with the latest poetry and science? These are not the elevators of society, but its ornaments. The flower can not elevate the stalk. Society is elevated just so far as it lifts its face toward Mount Sinai, and no more. The ten commandments are worth more as "elevators" than all the patent contrivances which the unregenerate mind of man can conceive.

Page after page of history gives the lie to such a theory. When were manners most elegant, wit most polished, culture most a fine art? In the palaces of Italy in the middle ages, in the courts of Louis the Grand and Foolish, in the halls of Henry and Charles; and where and when was society most rotten! No. it is a great mistake to suppose that fine manners *per se* elevate either men or women; nor have they any moral value except so far as they are the outgrowth and sign of a true respect and consideration, the ornaments of a society which loves truth and purity and justice.

But Mr. McElroy is particularly unhappy in choosing religious hypocrisy as an illustration of his theory. Nowhere have the effects of this most despicable trait of human nature been

more evident and harmful; it has ever been the dry-rot of religion, eating out all that was best and sweetest. He appears to be quite favorably impressed with the way "the pagans were chased into the bosom of the Church with blade and brand." Surely he has read Lecky's History of European Morals, and knows that this same Church, so zealous for the conversion of pagans, had plenty of austere dignitaries whose children ran up into the hundreds, until like Joseph's corn they left off numbering. Verily, she was a precious hypocrite, with her indulgences in one hand and her dripping sword and fagot in the other, but hardly a happy example of a "social elevator." It has been generally admitted, at least by Protestants, that the moral and religious pall which overhung Europe during the dark ages was due to nothing so much as to the foul vapors given forth from that pit of corruption and hypocrisy which is now offered us as a "social elevator."

But perhaps our friend has a squint toward Rome, and may take exception to this scoring of the mediæval Church. Unfortunately, however, the same criticism holds of the Protestant Church of to-day, though of course to a far less degree. Hypocrisy is the cancer of every *prosperous* religion, and is to-day eating out its heart. The so-called orthodox Church is losing its hold on the masses, and why? Because it pretends to believe what it does not believe; because it persists in averting its face toward the twilight dimness of the past, instead of looking onward and upward toward the morning light.

But what is true of religion is universally true, that hypocrisy is a curse. It is one of the foul blots on all progress, and there is no health in it. The fact that it accompanies progress makes it no more a social elevator than misery and sin, which also flourish under progress. To every soul is presented this choice: "Here, O soul, is thy mask of flesh; behind it thou mayst work what thou wilt without fear of detection; behind it thou mayst think pure thoughts and noble aspirations, or thou mayst wallow in filth and plot murder and theft, and none suspect thee if only thou be an expert hypocrite." What a sensation there would be if by a fiat of Omnipotence this earth-mask might be stripped off now, in this year of grace 1891, and each trembling soul be exposed naked to the light, even as it shall in that great day! What a hunting of holes and hiding of heads—some carried so very high! What an *exposé* of dark closets and skeletons, and almost forgotten cesspools and underground ways; and what a dividing of sheep from goats when all the masks of hypocrisy were torn away! No more secret eating of sweet, stolen fruit; no more safe and secret hatings and backbitings and plottings; for wrong-doing and evil-speaking would rebound with the

terrific force of a boomerang. Society would necessarily divide at once into two general classes: on the one hand the decent, the industrious, and the patriotic, those who had not seared their souls with sin, and who preferred good to evil; on the other, those who were unable to abandon their evil ways even under the penalty of publicity, and who would be left to herd by themselves and prey upon one another. Thus would heaven and hell be set up already on the earth. For the world is what man makes it.

And herein is seen the solution of that great mystery of the union of soul and body, apparently so incongruous, so hurtful. In no other way could the soul be forced to make choice between good and evil, and at the same time be left free and independent in its choice behind an impenetrable mask—two essentials for the formation of character. What shall be the shame and anguish of that soul which has abused this great opportunity, which has chosen to debase itself, in that great day when hypocrisy shall naught avail, when we shall see as we are seen and know as we are known! Now, wheat and tares grow together, and tares imagine themselves as good as wheat; for falleth not the rain on the just and on the unjust? But in the great winnowing-day tares shall learn that they are tares and trash. The remorse of the inebriate or opium fiend is the punishment of him who has wrecked his body merely; what shall be the remorse of him who discovers too late that he has wrecked his soul, and forever! That will be eternal punishment.

THE PRACTICAL OUTCOME OF SCIENCE.

By W. H. SMITH, M. D., Ph. D.

THE present is an age of scientific research, and in this is found the characteristic feature of the existing civilization. The ancients were our equals, if not superiors, in literature, but no nation of antiquity could for one moment compare with us in scientific achievements. In this respect ours differs from all the ages of the past. The laws of Nature have been investigated, discoveries made, and in a multiplicity of ways her forces employed to do the bidding of man.

Passing by the more familiar results of such researches applied in the form of inventions on every hand to some not so patent, it may be remarked that science has accomplished and is accomplishing the difficult task of prolonging the period of human life. This comes through the study of physiology, sanitation, and medicine, the result of which has been, as shown by Dr. Jarvis, in a

report some years ago to the Massachusetts Board of Health, that the average longevity, which at Geneva, in the time of the Reformation, was 21·21 years, between 1814 and 1833 had increased to 40·68, and that as many people would live to seventy as reached forty three hundred years ago. The records of annuities on life show the same fact, proving, strange as it may appear, that within the last three centuries the average period of human existence has nearly doubled.*

While those cognizant of such facts realize the benefits resulting from the applications of science, we sometimes hear it urged that such things are effected by the work of practical men, and that the theorists are useless. A more absurd and misleading idea was never expressed in words, and yet it is taken up and believed by people who never stop to question its truthfulness. In this respect it stands on a par with many an adage that passes current to-day. What, for instance, could be more fallacious than that "Contentment is better than riches," "Murder will always out," or "Brave men are never cruel," when history furnishes the records of Marius, Sulla, Haynau, and Napoleon, men whose courage was never doubted, but who were guilty of acts of cruelty that would disgrace any age? Absurd and untruthful as are these sayings, they are no more so than the statement that any class of men studying science can be set down as theorists who are of no benefit to humanity.

This can be made more apparent by the consideration of a few incidents in the lives of great men. For instance, John Hunter spent a large portion of his time in acquiring knowledge of anatomical facts which were regarded as useless by his so-called practical associates. He was a man who believed that no knowledge was unworthy of attention, and consequently dug deep into the foundations of his favorite science. By such studies he learned how the arteries changed, and that, when the main trunk was obstructed, the collateral branches enlarged sufficiently to carry on the circulation. At first this knowledge did not admit of any practical application. Finally, a patient came to him with an aneurism upon a branch artery. Hunter was thus given and embraced the opportunity of demonstrating the practicalness of his apparently visionary study, inasmuch as he at once boldly tied the main artery, which, up to that time, no surgeon had ever dared to do. The result was that the patient's life was saved, and a new and valuable operation introduced into the science of surgery.

Linnæus, more than a century ago, was spending his time in the visionary pursuit of bug-hunting, when the Swedish Govern-

* Quoted from Draper's Conflict between Religion and Science.

ment became alarmed at the fearful destruction of ship timber in its dock-yards by a minute boring beetle, and applied to him for a remedy. He replied that the beetle which laid the eggs only appeared in the month of May, and that by submerging the timber during that period it could be protected from its ravages. The Government did so, and thus not only saved its timber at an insignificant expense, but also brought the derided bug-hunter into respect, as one who had demonstrated the practical utility of his apparently visionary study.

Researches upon the properties of laughing-gas and ether and investigations relating to the peculiarities of infusorial life also exhibit knowledge which at first appeared absolutely worthless, but was afterward found to be exceedingly practical. Students originally took ether for fun, and laughing-gas fell to the level of a wonder exhibited by itinerant lecturers; yet out of that knowledge was destined to come our modern discovery of anæsthesia, by which surgical operations may be performed without pain and without the knowledge of the sufferer. In like manner the researches upon the infusoria, from the time of Leuwenhoek to Ehrenberg, had apparently no practical value, yet from their discoveries have been developed a truer form of one of the most important practical doctrines of modern chemistry, a modification of the practice of medicine, a revolution of the science of surgery, an application of new and more correct ideas in matters pertaining to agriculture; and, combined with all this, remains the probability that their power for usefulness is not yet exhausted.

For the sake of illustrating the difference between the practical man and theorist, let us suppose two persons to visit the northern peninsula of Michigan seeking for iron. The one runs along blindly, takes up with every good show, and mines. The result is, he either makes a happy strike by mere accident, or spends thousands of dollars in useless search. The other has studied the laws of electricity, and knows that certain ores of iron are magnetic. He understands also that these ores will exert their influence through any amount of superincumbent earth. Consequently he provides himself with a dipping-needle and compass, and by the operation of these tells where a bed is located, its approximate depth, and probable amount of material. To prevent being deceived by the magnetic schists in that region, by means of his dipping-needle and compass he traces up the bed until he finds an outcrop. Thus have been located, at little expense, many of the mining regions of that locality. What an achievement is this, and how much better than the blind guesses of the so-called practical man!

The history of that wonderful piece of mechanism, the steam-engine, furnishes another illustration of a different character. In

150 B. C., Hero of Alexandria invented a little instrument called an eolipile, which was driven by the agency of steam. To all appearances it was, and must ever remain, a useless thing; and it was not until the latter half of the eighteenth century that this peculiar contrivance, after having passed through the hands of De Gary, Porta, De Caus, Guericke, Savary, Papin, Newcomen, Smeaton, and others, was transformed, by the inventive genius of Watt, into a low-pressure engine. The history of this and other inventions shows three classes of men to have wrought upon them: First, there were the investigators, who were content with only discovering the great laws and truths of Nature. Then there were the teachers or historians, whose life-work was to treasure and disseminate the truths obtained. As the virgins in the temple of Vesta in ancient Rome kept the sacred fires burning, and would not permit them to go out, so these men preserved the knowledge thus obtained until the third class, known as the inventors, appeared and made the application.

How many, while admiring the objects attained by this third class, have ever given a passing thought to the labors of the two others, without which the last could never have accomplished such magnificent results? But are not the investigators of Nature's laws as worthy of honor and as useful to humanity as are the inventors? Shall we compare Newton with the man who first made a suction-pump? Galileo, the discoverer of the properties of the pendulum, with the manufacturer of a wooden clock? Archimedes, the investigator into the buoyancy of liquids, with the person who constructed the first dug-out? Certainly not! The men who investigate the great truths of Nature, and the teachers who disseminate those truths, and thus make invention possible, are as true benefactors to humanity as are the inventors, though, unfortunately, this latter class too often receive all the credit.

In this connection we may also see that no knowledge is useless. The discoveries which at first seemed only ornamental are frequently the forerunners of the most magnificent results. A little plant peeps through the earth, buds, and throws out its leaves, a thing pleasing to the eye. Presently it blossoms, the flowers ripen, and the branches hang with luscious fruit. In like manner many of the discoveries of the past, in their own day and age apparently worthless, have in a subsequent generation been found to be fraught with the greatest benefit to humanity. They began as things curious and pleasing only to the lover of Nature, but ripened into results of surpassing grandeur. The knowledge which at one time seemed useless, at another has been found exceedingly serviceable; and, since this has been true in the past, shall it not also be true in the future? If it took nineteen hundred years from Hero's time until a Watt appeared to invent a

steam-engine, shall any one deny the discoveries of to-day an equal chance? If the slight and apparently useless knowledge of the ancients in regard to electricity has been growing larger and larger until it culminates in our magnificent system of telegraphy and telephony, who dare predict a limit to the utility of any knowledge at present existing, however insignificant it may now appear?

Thus far we have been considering science in its bearing upon the physical wants of our race. However, man has a threefold nature—physical, intellectual, and moral; and, while science has been ameliorating the first, it has had an important influence upon the others. It is a great truth, in regard to all our powers, that they become stronger as we use them. Thus the blacksmith's arm grows sinewy by wielding the hammer. Even so it is with our mental powers. They are impaired by idleness and strengthened by exertion; and, in the "struggle for existence" or effort to attain the mastery over Nature, our intellectual faculties are brought into lively exercise and are accordingly strengthened.

In these days people are often asking which is the better education, the classical or the scientific; but, without attempting to consider that question, two facts may be observed: First, that language being the work of man, in its study the student can rise no higher than the source; and that Nature being the product of an omnipotent, omniscient, and omnipresent God, its study must lead a person

"Through Nature up to Nature's God."

The second fact is, that without scientific invention classical education would be impossible. Suppose the modern printing-presses and paper-mills were swept out of existence, how rapidly would linguistic study come to an end! The fact is, that scientific researches in a thousand and one ways have made linguistic study possible, and lifted humanity from barbarism to civilization.

It would be pleasing in this connection to note how the various intellectual faculties are improved by the study of the sciences. Memory, abstraction, generalization, reason, and, in short, all our powers can be thus developed. However attractive the topic, the space allotted to an essay of this kind will not allow dwelling upon the utility of scientific pursuits as a means of mental discipline, and they are passed by with the simple remark that the study of Nature, while beneficial to all our faculties, is peculiarly adapted to the development of our powers of observation. For this purpose there was no provision made in the old style of education; and how important it was that some training should be given in this direction must be patent to every one.

The Russian proverb says of the non-observant man, "He goes through the forest and sees no fire-wood"; and Dr. Johnson once

declared that "some men would learn more in Hampstead stage than others in the tour of Europe"; or, to take an illustration: In a cathedral at Pisa swung a chandelier. Thousands had passed in and out in an unthinking, heedless manner before Galileo's day, but when the young Florentine philosopher looked toward that ceiling, that chandelier, as a type of the pendulum, took on a new oscillation, and its vibrations extended farther and farther, until they reached the very center of the earth, and again swung outward toward other worlds, to return, bringing tidings of the gravitation that holds sway on those celestial orbs. In like manner a humble stone-mason at Cromarty, Scotland, saw on the rock some peculiar forms. He examined them carefully, and deciphered from these hieroglyphics the record of the "Old Red Sandstone," and from that time onward the name of Hugh Miller has been known in almost ever hamlet of civilized earth. The life of that illustrious Frenchman, Baron Cuvier, furnishes another and excellent illustration of the same thing. In the plaster-quarries of Montmartre, just without the environs of Paris, were lying scattered here and there a lot of animal remains. Thousands and doubtless millions of people had passed that way, and seen in them only so many old bones. Not so when Cuvier looked. The time had come for the arcana to be opened, and like the dry bones in the prophet's vision they became alive again and began to speak; and, wherever geology is studied, there the voice is heard chanting pæans of praise to the immortal Frenchman. His was not the record of a man who waded through seas of slaughter to write his name

> "Among the few, the immortal ones,
> That were not born to die."

Yet he has written it on an equally enduring tablet; he has writsen it on the history of geological progress, where it will endure *per secula seculorum*.

Science has also turned her attention to legal pursuits, and made her voice heard in courts of justice. Nearly every one doubtless is familiar with cases of men who have been arrested, charged with murder, and the blood found upon their garments examined. It is also probably known that there is some difference of opinion as to the degree of certainty with which human blood can be distinguished from that of an animal. This difference seems to be, in part at least, the result of the different methods pursued by the various investigators. Many persons suppose that the corpuscles are the only things to be examined. These are globular in shape and of about the same form for nearly all the mammalia. They, however, show a difference in size, and from this difference may be told approximately the animal from which they have been derived. There is another and equally valuable

method of distinction, which consists in breaking up the corpuscles. By means of a little acetic or sulphuric acid this may be accomplished, and then on slowly evaporating the solution we get crystals characteristic of the animal to which the blood belonged. By combining these two methods blood can be identified, not with absolute certainty, but with a high degree of probability.

However, probability is not enough. In a question where a man's life is at stake something more is demanded. Not probability merely but absolute certainty alone can satisfy the people. This in many cases we have. In 1852, in Essex, England, a man was tried for the murder of a woman. She had been found dead in her bed, with her throat cut from ear to ear. Among the prisoner's possessions was found a razor clotted with blood, and in the blood were detected two or three short cotton fibers. Taken and examined microscopically and compared with the clothing of the woman, it was found that in cutting her throat the assassin had cut through the strings of her night-cap, and these minute fibers of that remained as the silent witnesses of his guilt.

Sometimes mud or dirt adherent to clothes connects a person with crime, or a hair sticking under the nail of a boot may by comparison show that its possessor has trampled upon the head of the deceased; or, as in a case at Hull, England, the *Diatomaceæ* adhering to a man's shoes proved that he had been at the place where the murder had been committed.

Such are some of the ways in which the microscope aids us in ferreting out the assassin. It has, however, a wider application. Some years ago Ehrenberg, that old prince of microscopists, was employed by the Prussian Government to investigate a case of smuggling. A cask had been opened, valuables extracted, and the cask repacked, and shipped onward to its destination. The only clew to the criminals was that the unpacking must have been done at some of the custom-houses through which the goods passed. To all appearance, the microscope had a hopeless task. But not so. Ehrenberg took some of the sand that had been used in the repacking, placed it under his microscope, looked through his magic tube, and behold, there on the stand lay a peculiar specimen of *Foraminifera* That animal was found at only one place in the known world, and told at just what point the crime had been committed.

The history of England furnishes another illustration of the use of the microscope as a detecter of crime. A few years since the people were very much troubled about adulterations. Not only the tea and coffee they drank, but the food they ate, their medicines, and even their clothing were mixed up with foreign ingredients. In some cases this was carried to such an extent as to be simply diabolical. Wisely and well did the Government act.

Selecting one of the best scientists in the kingdom, they bade him investigate and prepare a remedy. The result was published in that book, Hassall's Adulterations Detected, a work that ought to make its author immortal. He there shows how all bodies differ in the minute structure of their granules, and renders it as easy to tell the genuine article from its adulterations as to tell apples from potatoes.

Some years ago a trial at Salem, N. Y., illustrated the value of science in questions of testimony. A man named Thomas Page, to gain possession of certain property, had forged a conveyance. The instrument purported to have been written in 1827, and was on paper colored blue with ultramarine. It was conclusively shown that ultramarine was not discovered until 1828, and not used in the manufacture of paper prior to 1841. By showing also that the paper was made on a Fourdrinier weaving-machine and by the calendering process, scientific and other evidence proved that it was probably not manufactured before 1845, and certainly could not have been in existence in 1827. The result was the overthrow of Page's suit, followed by his own prosecution, conviction, and sentence for forgery.

There was a time in the past history of the earth when, if a murderer could secretly place poison in the food of his victim, he might hope to accomplish his heinous purpose without fear of detection. Not so to-day. Chemical and microscopical analyses are applied to the stomach of the deceased, and with the symptoms reveal, not approximately, but with perfect and absolute precision, the cause of death.

But why stop to mention single instances when the records of jurisprudence everywhere are full of cases where science has been applied to legal affairs? The judicial investigation of such crimes as poisoning, wounds, infanticide, abortion, rape, illegitimacy, to say nothing of the deeds caused by insanity, must ever receive a large amount of aid at the hands of medical science.

In these Science does not always appear as an avenging Nemesis, hunting down and punishing the guilty. She sometimes plays the *rôle* of the vindicator of the innocent. Dr. Lyons gives an account of a case in which a man was arrested and charged with murder. A hatchet, smeared with dried blood and hair, was found under his bed. Indignation ran high, and people were almost disposed to lynch him. He was, however, detained, and the blood-stains and hair subjected to microscopical examination, when they were found to be those of an animal which he had killed and had then carelessly thrown the hatchet under the bed.

Such are some of the practical benefits accruing to us from scientific research. With Briarean arms it has reached out and laid hold of every part of our civilization. Proteus-like it as-

sumes a thousand shapes, but under every guise remains still the firm friend of the human race.

Nor have the triumphs of science been less in the moral than in the physical and intellectual world. When the curtain of antiquity rises upon our race we find its moral condition of the lowest and most degrading character. What, then, has raised man out of that condition? It may have been revealed religion; but, in my opinion, scientific progress, by introducing higher and grander ideas, had much to do with it. Whatever may have been the cause, we have certainly left forever the dark ages of our fathers' beliefs. If we find a woman troubled with nervous disorder, we no longer look about for the person who has bewitched her, and cast that person into the water to be drowned as innocent, or to float and be burned as guilty; but we simply treat the woman for hysteria. If a man falls down and goes into convulsive movements with foaming at the mouth, we are not accustomed to follow the example of the ancient Greeks and Romans, and say he is possessed with an evil spirit; but we give him bromide of potassium or some other remedy to cure his epilepsy. If a plague or pestilence break out and sweep away half a city, we do not place our reliance on sacrifices and supplications addressed to the deities to avert their anger; but we seek the cause of it in a lack of cleanliness and remove the filth. We have learned that these things may be punishments sent from God, yet they come mediately, not for a moral sin, but for violating one of the physical laws of our being. Science found mankind everywhere believing that each tree, bush, or dark recess was peopled by an evil demon; but by the glorious sunlight of the nineteenth century she has banished these shapes of darkness from off the civilized earth, and planted in the brain of the people that intelligence, greater than an angel with a flaming sword, which shall forever prevent their return.

And then the ideas in regard to God, derived from the study of Nature, how surpassingly grand! The old Hebrew seers may have taught that Jehovah was infinite in power and wisdom, filling immensity with his presence, and existing from everlasting to everlasting; but it remained for astronomy, geology, and microscopy to show the profound significance of such utterances. Nothing is more humiliating than the study of Nature, However viewed, she but reflects back upon us the infinite wisdom and glory of her great designer.

Such have been some of the achievements of modern Science. She has, as it were, made a palladium out of the bones of Pelops. She has, indeed, been a mother of plenty, scattering blessings everywhere with a liberal hand. As the gods in ancient times are fabled to have piled Pelion upon Ossa, and rolled upon the

top the leafy Olympus, in their daring efforts to scale the heavens, so modern Science has raised mountain on mountain high in her effort to rise to the eternal source of truth. She may not have sent Abaris around the earth on an arrow, but with lightning-like swiftness she sends our messages from ocean to ocean and from continent to continent. Her votaries may at times have seemed to some narrow-minded persons about to hang a Nessus shirt upon humanity, but, when the garment came to be received and understood, it was found to be not only destitute of the hydra venom, but filled with the greatest blessings for our race. Thus has Science wrought, opening up Hesperian gardens with their golden fruit, and, while scattering physical, intellectual, and moral benefits on every hand, has impressed upon man the grand truth that

"No pent-up Utica contracts his powers,
But the whole boundless continent is ours."

DRESS AND ADORNMENT.

I. DEFORMATIONS.

By Prof. FREDERICK STARR.

FOR our course of lectures in anthropology this year we have selected a single subject: *Dress and Adornment.* This will be treated in four lectures upon the following topics: 1. Deformation. 2. Dress. 3. Ornament. 4. Religious dress. It is not claimed that the treatment is exhaustive; it is hoped, however, that it will be suggestive. Nor is it the lecturer's expectation that his audience will agree with him in all his views; he simply asks a fair consideration.

The question as to whether beauty is a something inherent in an object or a person, that appeals to a universal sentiment of mankind, is one that has been much debated. The metaphysician and the anthropologist are likely to answer the question differently. There is certainly no one ideal of personal beauty that appeals to all the world alike. The face most beautiful to us would be displeasing to a Hottentot. We may well look for a moment at some ethnic ideals of beauty. The negro admires blackness; Clapperton tells us that among certain Africans the white color of the skin, of which Europeans are so proud, excites only pity, astonishment, or terror; the Chinese dislike our noses, which they say are like the beaks of birds; the woman in Cochin-China sighs to be round like an apple; and the Hottentot women do not look with disfavor upon those enormous fatty outgrowths above the hips which to us appear frightful. So a

certain woman of the Nile tribes told Sir Samuel Baker that Lady Baker should have had her four lower incisor teeth knocked out and her lower lip pierced for a quartz labret—"by that she would become very beautiful." Thus we see, while all tribes have some ideal of beauty, it is an ideal which varies infinitely, and which has grown up among the tribes independently. All desire to attain to the ideal after it has once been established; and Tylor tells us that for this reason Hottentot mothers manipulate the baby's nose to make it more snub, while Persian mothers try to make it aquiline. In many cases, as we shall see, simple manipulation is not enough, and more heroic measures are taken to produce the desired effect.

Looking over the whole field of ethnology, we find a wonderful variety of curious deformations, mutilations, and modifications which are considered beautiful. Of these we shall describe a considerable number, commenting upon some as we mention them, and then shall try to draw from them some general principles of importance. For convenience, we shall group all bodily changes made for the sake of increasing personal beauty into four groups: 1. Perforations and filings. 2. Bandagings. 3. Color decorations, etc. 4. Hair-dressing.

First, then, as to perforations and filings—or mutilations. Many parts of the body are mutilated, either in order to make them serve as carriers of ornaments, as direct improvement of personal beauty, or for some useful end. The lips easily lend themselves to such an operation, and pierced lips are found in South America, in Africa and in the extreme Northwest of North America. The custom of piercing the lips in the past was also widely spread. The standard example is, of course, the Botocudo of South America, whose name comes from the Portuguese word for a plug, referring to the ornament inserted in the opening. These people wear, in lips and in ears, great circular disks, sometimes of hard and heavy wood, weighing even a quarter of a pound. This lip-plug drags the lip down to a horizontal position. Flower quotes Dampier as saying, in 1681, of the Corn Islanders, off the Mosquito Coast: "They have a fashion to cut holes in the lips of the boys when they are young, close to the chin, which they keep open with little plugs till they are fourteen or fifteen years old. They then wear beards in them, made of turtle or tortoise shell. The little notch at the upper end they put in through the lip, where it remains between the lips and the teeth; the under part hangs down over their chin; this they commonly wear all day, and when they sleep they take it out. They have likewise holes bored in their ears, both men and women when young, and by constant stretching with great pegs they grow to be as big as milled five-shilling pieces. Herein they wear pieces of wood, cut

very smooth and round, so that the ear seems to be all wood, with a little skin around it."

In ancient Mexico labrets were worn, and very pretty little ones made of black obsidian and finely polished are not uncommon. These are shaped like a stove-pipe hat, the brim being placed between the lip and the lower teeth, and the crown projecting from the middle of the chin. Such labrets, although usually of obsidian, are sometimes of jade, and were occasionally of large size. Curiously enough, this same style of lip-plug is found among the western Eskimos. Within a century the custom of piercing the lips for labrets was prevalent in Alaska and British Columbia. The ornaments were sometimes three inches long by one and a half wide, of an oval form, and hollowed into troughs above and below. In fact, it is said that the Ahts took out the labret and used it as a spoon in eating hot soups, etc. Among the Tlingits of Alaska the women only wore labrets. The girl's lip was pierced as she approached womanhood, and a very small peg inserted in the opening. This hole was enlarged by the insertion from time to time of ever larger labrets. Only women of great age and high position wore the largest ones. The practice is now falling into disuse, and large labrets are almost a thing of the past. Small pegs of silver are the customary form at present.

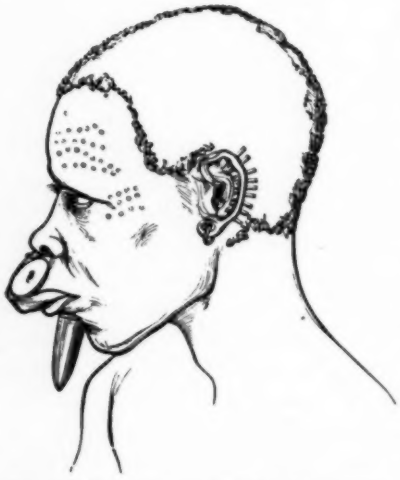


FIG. 1.—AFRICAN WEARING LIP ORNAMENTS.

In Africa labretifery is quite as common, and varies from tribe to tribe. The Loobah wear a polished cone of quartz, some worn by men being even two inches in length. Mittoo women wear circular plates (Fig. 1); the Bongo wear plugs in both upper and lower lips, and seem to delight in the noise made by the ornaments striking together. Schweinfurth, from whom most of these African examples are taken, says these same Bongo women wear bits of straw in holes at the edges of the nostrils, a clamp at the corner of the mouth, and numerous little iron rings in their ears. "Some of the women have the body pierced in little less than a hundred places." Nuehr women wear in the upper lip a small ornament of iron wire covered with beads, which at a little distance looks like a cigarette in the mouth. Yet more curious is the *pelele* worn by the Manganya women (Fig. 2). It is a *ring*, made of metal, ivory, or

bamboo, sometimes two inches in diameter, and worn in the upper lip. When the muscles of this lip contract, they throw the ring upward, so that the nose appears through the hole.

FIG. 2.—MANGANYA WOMAN WEARING PELELE.

But the lips are not alone in the matter of being perforated for insertion of ornaments. The nose is often pierced, and this may be in two ways, either through the septum or through the walls of the nostrils. Captain Cook (quoted by Flower) says of the east Australians: "Their principal ornament is the bone which they thrust through the cartilage which divides the nostrils from each other. . . . As this bone is as thick as a man's finger and between five and six inches long, it reaches quite across the face, and so effectually stops up the nostrils that they are forced to keep the mouth wide open for breath, and snuffle so when they attempt to speak that they are scarcely intelligible to each other."

The ornaments put through the walls of the nose vary greatly. There may be but one perforation in each wall or there may be several. In New Zealand flowers, in New Guinea a boar's tusk, in the Solomon Islands a crab's claw, in New Britain thorns, set upright, are the objects thus worn. These are all original and primitive; after the natives come in contact with whites, these give place to metal buttons and rings. In the Sturgis Collection is a rather pretty nose-ornament from New Guinea. It is V-shaped, and the arms fit by stud-shanks, one into each wall of the nose. Nose-ornaments were known to the Jewess of the exile—Ezekiel, xvi, 12, "And I will put a jewel on thy nose"; and Isaiah, iii, 21, "The rings and nose-jewels." The *cheeks* are pierced by some Eskimos, who wear little round stud buttons in the holes. *Ears* are pierced the world over. A few cases must suffice. Schweinfurth says that Babucker women pierce the rim of the ears repeatedly and wear therein bits of straw an inch in length, having twenty such, perhaps, in each ear. This repeated piercing of the ear is common among barbarous people, and we have seen a woman of the Sac and Fox Indians who wore seven brass rings in one ear. Ears may be slit and stretched instead of pierced. They then hang in long loops. Catlin gives a picture of an Indian whose beauty had been increased in this way. The Anchorite Islander slits his ears (Fig. 3), while the Fijian often has

them slit and stretched to such an extent that the two fists might be placed in the openings. Slit ears may be of practical use. The Kaffir carries his snuff-box in his ear-hole, and Captain Cook figures a Mangaia Islander who carried a large knife in his right ear.

"The Dyaks not only pull the lobes down to the shoulders, but also insert a number of brass rings around the rim. One man wore a large ring in each ear with smaller rings attached to it from which were pendent various articles. To one ear were thus attached two boar's tusks, an alligator's tooth, part of a hornbill's beak, three small brass rings, and two little bells." Among the Bongo we find the flesh of *the abdomen* slit for the insertion of sticks.

FIG. 3.—ANCHORITE ISLANDERS WITH SLIT EARS.

Akin to these perforations are the various forms of filing, boring, and breaking of teeth. The great districts for such deformations to-day are Australia, Malaysia, and Africa. In times gone by these were prevalent in Central America and Mexico, and Hamy describes a number of varieties. In Africa a score or more tribes file their teeth. With them it serves as a tribal mark. Thus the Batoka knock out the upper front incisors and let the lower ones grow up above the jaw. The Bongo. Kredy, Asango, and others chip and file them to various forms. The most elaborate designs, however, are found among the islands of the Indian Archipelago, where teeth are chipped, filed, engraved, bored and fitted with brass-headed brads, and dyed so that white patterns appear on a black ground (Fig. 4). In these cases the decorative idea is prominent, although—from the fact that Dyaks, Ryangs, and Batta differ in pattern and style—the custom retains, even here, some tribal significance. Notice the two purposes of the practice—(1) as tribal marks, (2) as a decoration. It should be also observed that many and curious reasons are assigned for the practice. The Batoka, for instance, say "they wish to resemble the cow, and not the zebra." Very generally these operations, like so many other mutilations, are performed as the individual approaches manhood or womanhood. In Australia it is markedly an initiatory practice, a recognition of the child becoming adult, a reception into the tribe.

The second group of bodily deformations is that of bandagings —various and widely spread. With these we may consider some freaks of unrestrained growth. In China and Siam the finger-nails are allowed to go uncut and attain great length. In China they are carefully oiled and kept in tubes; in Siam they are incased in silver tips. In China they also occur among religious ascetics. In all these the meaning is clear. The person with such nails does not and can not do ordinary manual labor. Hence they are a sign of nobility or of sanctity. The Marquesas Islander also wears his finger-nails long and pointed as a sign of rank. Of true bandaging — every one knows of the dwarfing of the Chinese woman's foot — the practice is confined to women, though not to women of the highest rank. Flower describes the physiological action and result of this: (*a*) Operation: "The four outer toes are bound under the sole in such a way as to leave the great toe only in a normal position and to bring the whole foot to a narrow point in front. (*b*) Results: The roots of the heel and toes are compressed downward and toward each other, shortening the foot and making a deep transverse fold in the middle of the sole." The subject of the operation, which is begun in childhood, is, of course, crippled for life. The bandaged foot becomes also an object that must not be seen, a disgrace; and yet the Chinaman calls it a "golden lily." In the Philippine Islands women bind their arms in order to gain the ideal of womanly beauty, a large fist. The results would even suit the present taste of Boston. The Wahamba, in East Africa, bind the legs of children, up to the knee, to make them calfless, "that they may run better"; while the Puris women, in South America, *develop* the calf excessively by bandages above and below, "for beauty."

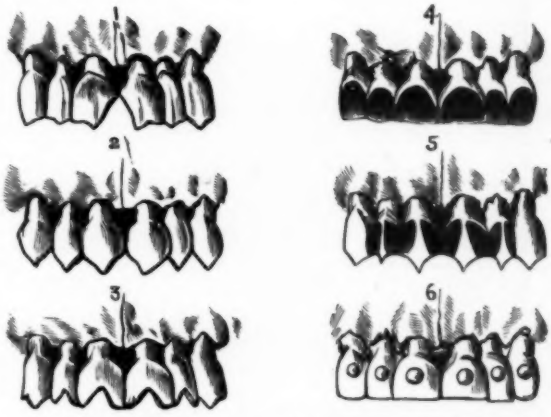
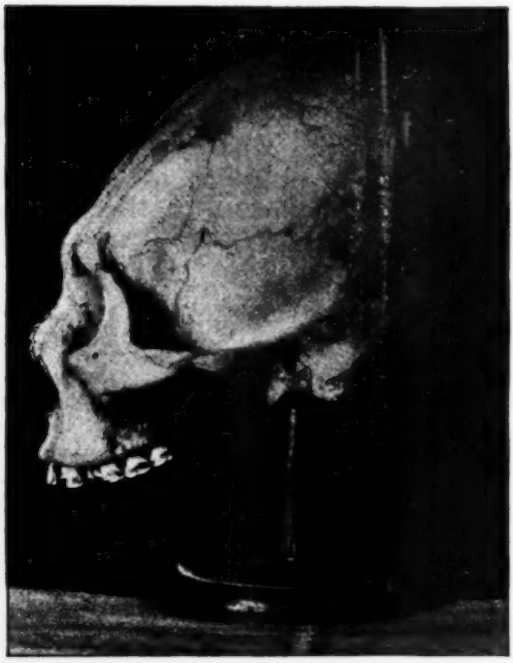


FIG. 4.—TOOTH-FILING—MALAYSIAN EXAMPLES.

The most remarkable bandaging, however, is that of *the head.* Deformation of this kind has a wide range in time and space. Hippocrates speaks of it 400 B. C., and it still exists. And where has it *not* prevailed? It is known to have existed in the Caucasus, the Crimea, Hungary, Silesia, Belgium, France, Germany, Switzerland, Polynesia, China, and other parts of Asia. Nowhere, how-

ever, has it been more prevalent than on the western coast of both Americas. Of old races the Peruvians, Yucatanese, Mexicans, Caribs, Natchez, and some of the mound-building tribes deformed the head. In later days many tribes along the Northwest coast from Oregon to the Tlinkit territory have—or lately have had—the fashion. The method of applying the pressure varied. Sometimes a board was fastened firmly against the forehead, space being left between it and the back board of the baby-frame for the head to grow backward and upward to a wedge-form. Sometimes bands of cloth or bark were bound around the head so as to force the growth either upward or backward. All sorts of classifications of the various forms have been suggested. Three types, however, are particularly striking: (*a*) The "flat-head"—wedge-shaped; (*b*) the long cylindrical; (*c*) the "sugar-loaf." Ten different forms



FIGS. 5 AND 6.—DEFORMED SKULLS.

have been described from Peru alone. All the important types may also be found within a very limited area surrounding Vancouver Island. Several questions arise in connection with this practice. Is the operation painful? Are the effects harmful? Is the result hereditable? "It might be supposed," says Mr. Kane, "that the operation would be attended with great suffering, but I never heard the infants crying or moaning, although I have seen their eyes seemingly start out of their sockets from the great pressure; but, on the contrary, when the thongs were loosened and the pads removed I have noticed them cry till they were replaced. From the apparent dullness of the children while under the pressure I should imagine that a state of torpor or insensibility is induced, and that the return to consciousness caused by its removal must be naturally followed by a sense of pain" (Fig. 7) (Flower). Are the effects of such alteration of the skull hurtful to the brain? Most authors agree that in savage or barbarous life little or no harmful result comes. This belief is founded upon two facts: (1) the individuals deformed appear quite as intelligent as their neighbors; (2) in such tribes as hold slaves the deformation exists only among the free population. Were the masters seriously affected by it in mind, they would ere now have become themselves the slaves. In civilization sad results follow. Dr. Foville proves that it causes headache, deafness, cerebral congestion, epilepsy, and worse brain troubles (Flower). As to heredity, Hippocrates claimed that the tendency to abnormal form of head *did* become hereditary; recent authors, as a rule, do not agree with him.

FIG. 7.—FLATHEAD CHILD.

The third group of deformations or bodily alterations is color decoration, and under this we shall class body-painting, tattooing, and gashing.

Body-painting and face-painting are universal. The Gani wear no dress, but paint the whole body. Thus: "Two messengers were painted—their faces were white; the bodies were painted in two coats of purple and ashen-gray; the latter was scraped off so as to show the former in patterns below. Some men paint the body in horizontal stripes like the zebra, or in vertical stripes down the back, or with zigzags of a lighter color."

All our North American Indians paint, and the patterns vary with the individual, with the family, and with the occasion. From notes made upon Sacs and Foxes painted for the dance we will give but one or two cases. One man's face was painted black, except around the eyes and mouth, which were scarlet. Upon

his forehead was a neat checkered pattern of yellow on the black background. Another's face was divided by a vertical line in two parts, one of which was a bright yellow, the other an equally bright green. Among the Fijians face-painting is carried to the extreme—e. g., "face all scarlet except nose, which is black;

FIG. 8.

face divided like a quartered heraldic shield and painted red and black or white; black face, white nose, scarlet ring about each eye, and a white crescent on forehead," etc.

And of our own ancestors, the Britons, Cæsar said: "All Britons, however, paint themselves with woad (*vitro*), which gives a dark-blue color, and by this means they appear terrible in battle; they wear long hair, and the whole body is shaved except the head and upper lip" (v, xiv).

And we may select a last example from Egypt. Loret says the ancient Egyptian women had blue hair, green eyelashes, painted teeth, and reddened cheeks. He says the modern Egyptian women are much the same; they tinge their hands with henna, and prolong the eyes by means of kohol; they stain the nails brown, and paint blue stars on the chin and forehead. "One hesitates a little about putting his hand into a hand—even very small—which extends itself to you painted a brick-red. One is

a little timid about looking too long into eyes—even very tender —when the blue star between them makes you squint." Loret, however, got bravely over both his hesitation and his timidity, and thinks the fashion not altogether bad.

This body-painting is the most *individual* of all the modifications we are to consider. Each person in it exercises his own personal caprice or fancy. It is greatly esteemed. To get material the Huron Indian went twenty miles. Painting serves several purposes: (*a*) Tylor says the Andaman Islander plasters himself with lard and colored clay *as a protection* against mosquitoes and heat. (*b*) In most of the cases cited, painting is simply for display. (*c*) It often serves as a sign of mourning. (*d*) In the "woad" of the Briton and the "war-paint" of the Indian the purpose is to strike terror. Mougeolles suggests an origin for the practice that seems to us quite reasonable. Red is the commonest color used in body-painting; it was probably the earliest. The man who returned from battle covered with blood of hostile man or savage beast was a hero. Such a one might easily seek to constantly remind his neighbors of his success by replacing the real blood-stains by artificial ones as the original wore away. Humboldt says of the Orinocos that "*no paint* was a dishonor," but also that it was a chief's attribute, and that the chieftaincy was the reward of bravery. Herodotus says that "Thracian *chiefs* painted as a distinction. And, when in Rome, the victor ascended the Capitoline Hill painted with minium, there can be little doubt that he was simply using a very old symbol — of bloody victory.

Painting is temporary and needs frequent renewal. In many parts of the world we find color designs, elaborate, curious, sometimes beautiful, made permanent by tattooing. The pattern and the method vary greatly with locality. In some regions men only tattoo, in others only women, in others both sexes. Here it is confined to the nobles, there to the servile. In Abyssinia women chiefly tattoo. "The whole body is covered; even the gums are pricked blue. An old woman operator's tools were: a pot of blacking (charred herbs), a large iron pin, bits of hollow cane, and pieces of straw—these last for pencils. She marks out the design, pricks dots with the pin loaded with the dye, and goes over it repeatedly. To allay the subsequent irritation it is plastered over with a green poultice; the scab must not be picked off" (Wood).

Very different, and only interesting because of its novelty, is the method of tattoo found among some Eskimos. The pattern is sketched and threads are passed *under the skin*. These threads are loaded with pigment, and are drawn back and forth until the pigment is taken into the skin, when the threads are removed.

But the most remarkable examples are to be found in the Pacific islands. In the Marquesas Islands the patterns often represent animals: the head is covered with one design, the breast bears a shield, the arms and thighs are striped, the back is crossed, and each finger bears its own pattern. The tattoo is here applied to both sexes, though mainly to men. It is begun at nineteen or twenty years, and is rarely finished before forty. The instrument used is a small comb-chisel. The figure is drawn on the skin, the comb is dipped in ink of burnt cocoanut-shell and water, and driven by a mallet through the skin. Only a few square inches are tattooed at one time. The spot swells and becomes sore, with fever.

In New Zealand we find quite as remarkable a condition of things. The patterns here are composed of curves and spirals. The general design is conventional, and the lines of which it is composed bear special names. *These* may vary indefinitely in minor details. A difference of importance is found in the method of tattooing in New Zealand and that prevalent throughout *Polynesia*. Here the lines are *cut*, instead of being pricked in by points. "The patient lies on his back, with his head between the knees of the squat operator, who draws the outline in black pigment and slightly scratches it. The chisel, of tooth or a bird's bone, is then taken and the pattern *cut* through the skin. The operator dips the edge of the chisel constantly into the pigment and rubs it into the cut each few inches, using a little bunch of fiber. The cutting is done by hammering the chisel, not by a knife. The complete pattern takes two or three years. During the operation friends sing, to drown the groans of the subject" (Wood). In Japan the tattoo was formerly very common, but is now prohibited by law. Such designs as "a monster crab on the small of the back, a pretty cottage on the chest, or a scarlet fish between the shoulders," were common (Fig. 9). As to the origin and meaning of the tattoo we can scarcely err in regarding it the same as for painting. The victor returns stained with blood and

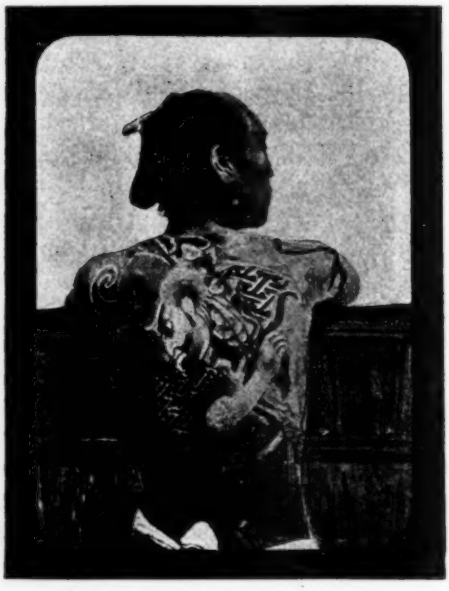


FIG. 9.—JAPANESE, SHOWING TATTOO.

bearing an honorable wound. This is replaced by an artificial wound to show his prowess. We actually find *this* practice in Kaffirland, and the Tuski makes a permanent mark upon his face for each act of courage. The idea once originated, the arrangement of such scars in an ornamental fashion and the adoption of colors would gradually arise, and in time the whole matter would become simply ornamental, a sign of rank, or religiously symbolical.

Gashing is a most remarkable custom, best studied in Africa and Australia. In Africa, gashes cut upon the forehead, cheeks, breast, or elsewhere, serve two chief purposes: (1) as tribal marks; (2) as signs of prowess. The Yorubas have perpendicular scars from temples to chin; the Ijasha have a long parallelogram of cross-lines; the Maheés, three long oblique cuts on one cheek and a cross on the other; the Nyambanas, pimples or warts, the size of a pea, from the top of the forehead to the tip of the nose (Fig. 10). These gashes are usually made with a knife, and wood-ashes or some other irritating material is rubbed in, to cause a swelling scar.

FIG. 10.—NYAMBANA TRIBAL MARK.

To what an extent these cuttings are carried may be seen in the Bornu, where "twenty cuts on each side of the face, converging in corners of the mouth, from the angle of the lower jaw and the cheek-bones, while a single cut runs down the center of the forehead; six cuts are made on each arm; six more on the thighs; the same number on the legs; four on each breast; nine on each side above the hip-bones. These are made in infancy, and the children suffer not only from the pain of wounds but from the countless flies that settle on the *one hundred and three* cuts."

As a sign of war prowess, the gash of the Kaffir warrior, already mentioned, may be described. After an act of bravery, the priest cuts a deep gash in the hero's thigh. This heals blue and is a prized honor. Interesting examples of scars as tribal marks might be described from Australia. To realize the value of a

tribal mark, think for a moment of the savage man's relation to the world outside. He is a very Ishmaelite. So long as he remains on his own tribal territory he is safe; when on the land of another tribe, his life is the legitimate prey of the first man he meets. To men in such social relations the tribal mark is the only safety at home; without it he would be slain unrecognized by his own tribesmen. There must have been a time when the old Hebrews knew all about this matter of tribe marks. By this custom only can we fully understand the story of Cain (Gen. iv, 14, 15), who fears to be sent from his own territory lest he be slain by the first stranger he meets, but is protected by the tribal mark of those among whom he is to wander being put upon him. "I shall be fugitive and vagabond in the earth, and it shall come to pass that every one that findeth me shall slay me. And the Lord said unto him, Therefore whosoever slayeth Cain, vengeance shall be taken on him sevenfold. And the Lord *set a mark upon Cain*, lest any one finding him should kill him." But in scarring, as in so many other cases, the original idea is often lost, and the mark becomes merely ornamental. This is particularly true among women. Among men it more frequently retains its tribal or religious significance.

FIG. 11.—BATOKA HAIR-DRESSING.

And last of the groups is *Hair-dressing*, which is wonderfully varied. Africa is again the best field for study. The Batoka works the hair into the form of a ring and then builds it up into a cone, piecing it out with the hair of beasts, and adorning it with red ochre (Fig. 11). The Kaffir, when he is no longer a boy, goes to a friend to have his hair dressed. "The friend takes an assagai, sharpens it carefully; takes gum, sinews, charcoal, and oil. He makes an oval ring of sinews half an inch thick, and fits it firmly over the head. He then weaves the hair into this, and fixes it with gum and charcoal. Oil and grease are applied until all shines. The head is then shaved, except the ring. This is variously useful—holds feathers firmly,

carries snuff-spoons, etc.," in addition to its value as a distinction. Of one tribe it is said that they wear most exquisite helmets, formed of their own hair; these cost an infinity of care and trouble and time, and are resplendent with beads, ostrich-plumes, and metal crest. To attempt the barest outline of the diversity of hair-dressing, however, would take us too far. With two or three examples, outside the African area, we must stop. The Fijians are remarkably fond of grand coiffures. Williams tells us that "many chiefs have a special hair-dresser, to whom they sometimes devote several hours a day. Their heads of hair are frequently three feet in circumference—one was nearly five feet. They also dye their naturally black hair at times to white, flaxen, or red." A curious point may be mentioned in this connection.

Such head-decorations would be injured were one to lie down and rest his head upon the ground, so a special type of wooden pillow is used in Fiji. It is placed under the neck, and keeps the hair free of the ground. Similar pillows are found wherever such care is bestowed in hair-dressing—as in Africa and Japan to-day, and in Egypt thousands of years ago. The cases already given are ornamental simply, or indicative of rank; hair-dressing may, however, become a tribal or family mark. The Siamese tuft—"lotus bud"—is such a case, as are also the Chinese queue, and the curious styles of hair-dressing that distinguish *gentes* among our Indian tribes.

FIG. 12.—FIJI PILLOW.

Here we have a *host* of curious customs before us. From them we may draw some general conclusions. Leaving for the present all the *religious* significance of these mutilations and deformations aside, we find—

First. These alterations are an actual gain or advantage in several ways: (*a*) as tribal marks; (*b*) family signs; (*c*) social distinctions.

Second. Whatever the actual original significance of deformations, they illustrate the action of two important *contrary* laws: (*a*) A law of strife for self-assertion or individualization; this really operates as the beginning of every one of these we have considered. The man who has *done something*, feels himself to be some one—desires to mark himself off from the rest visibly. (*b*) But the law of imitation leads to that which was at first an individualizing thing, becoming customary and fashionable.

Third. These deformations are all *beautiful* to those who practice them. Is it not evident that in all of them the idea and the ideal of beauty are subsequent—*not* antecedent and original?

PROFESSOR HUXLEY AND THE SWINE-MIRACLE.

By W. E. GLADSTONE.

THE controversy, in which this paper has to take its place, arose out of a statement, indeed a boast, as I understood it, by Prof. Huxley,* that the adepts in natural science were assailing the churches with weapons of precision, and that their opponents had only antiquated and worthless implements to employ in the business of defense. I took upon me to impeach at certain points the precision of the Professor's own weapons.† Upon one of those points, the miracle of the swine, as recorded in the Gospels, he had given us assumption instead of proof upon what he thinks the vital question, whether the keeping of the swine was an innocent and lawful occupation. He has now offered an elaborate attempt at proof that such was its character. The smallest indication of such an attempt in the original article would have sufficed entirely to alter the form of my observation, which would then have been what it will now be; not that he offers no argument, but that his argument is unsound from the beginning to the end.

Of that considerable portion of his article which is devoted to sneers, imputations, and lectures against myself, I shall take no notice whatever. The question of my guilt or innocence is too insignificant, and even the question whether Mr. Huxley does or does not always use weapons of precision might hardly warrant a prolongation of the warfare. But the personal action of our Lord is the basis of the Christian revelation, and to impugn it successfully in any point is to pierce the innermost heart of every Christian. No inquiry, therefore, can be too painstaking which helps to carry such a question to a conclusive issue.

I must, however, in passing, make the confession that I did not state with accuracy, as I ought to have done, the precise form of the accusation. I treated it as an imputation on the action of our Lord: he replies that it is an imputation on the narrative of three Evangelists respecting Him. The difference from his point of view is probably material, and I therefore regret that I overlooked it. From the standing ground of those who receive the

* Nineteenth Century, July, 1890, p. 22. [Popular Science Monthly, September, 1890, p. 649.]

† Impregnable Rock of Holy Scripture, p. 260.

Scriptures, it is not so considerable. That Christ, who is not only the object of imitation, love, and worship, but the very food and life of Christians, is the Christ of the Gospels. In a sense relative yet not untrue, they may almost be called "the brightness of His glory and the express image of His person."* If the Gospels are put on their trial as literary documents, and if a legitimate though mordant criticism can successfully impugn any portion of them, we can not complain, and must take our chance. But when their contents are summarily condemned and rejected on a charge of intrinsic unworthiness and immorality, upon no higher authority than that of the private judgment of this or that individual, then, and so long as we are dealing with a portion of the attested portraiture, an arraignment of them becomes, at least in my view, more hard to distinguish from an arraignment of Him whom they portray. Told, and told in detail, by all the three Synoptics, the miracle of the demoniac and the swine does not well bear severance from the staple of the biography. Nor, indeed, is it so severed by Mr. Huxley,† who frankly treats it as involving at large the authority of the Synoptic Gospels. In itself, it is undoubtedly of the utmost significance, on account of the questions which it raises. One of these is the large subject of demoniacal possession, on which I do not presume to enter. Another is whether our Saviour in answering the prayer of the evil spirits by "saying unto them, Go," became a co-operator in the destruction of the swine. This has been contested, but I pass by the contest, and for argument's sake at least admit the affirmative. Then there remains the further question; whether the beneficent ministry of our Lord on earth included in this instance the infliction of heavy injury upon certain individuals, the owners, or keepers and owners, of the swine, by the destruction of their property lawfully and innocently held?

Mr. Huxley observes that the Evangelists do not betray any consciousness of the moral and legal difficulties involved in the question. But if the Evangelists believed that our Lord was dealing in this case with Hebrews, or with persons bound by the law of Moses, then for them, believers in the Messiah, there were no legal or moral difficulties at all.

There are, indeed, those who have been content to rest the case on the absolute right of the Deity to deal at will with the property of the creatures whom he has made. "Of thine own have we given Thee!" Commentators are far from uniform.‡ But, as it appears to me, the question does not come before us quite in this shape. Apart from any such contention, it is no trivial in-

* Heb. i, 3. † Nineteenth Century, December 1890, p. 968.

‡ Consult Cornelius *a Lapide*, and his references to others, on Matt. viii, 28–34. Thomas Scott's commentary is worthy of notice.

quiry whether we have to record in this case the existence of an exception to the general character of our Lord's ministry, which was both beneficent and law-abiding. So far as regards the taking of animal life, the matter need not be discussed. It was life destined to be taken, taken by violence and probably with greater pain. It may have been, undoubtedly, the highest practical assertion of power, which is recorded by the Evangelists. But there is a remaining question, namely, whether this assertion of power was such as to involve serious injury to the proprietary rights of innocent persons. This is the character which Prof. Huxley stamps upon the narrative; justly, as he thinks, but, as I hold, in defiance of historical authority, and of the laws of rational and probable interpretation. I can not, however, but agree with him on two points which appear to be important: namely, first, that the excision on moral grounds of this narrative from the Synoptic Gospels affects their credit as a whole, and, secondly, that it is material to know whether the act recorded involved the infliction of a heavy penalty upon conduct in itself innocent.

The first question that arises in approaching this inquiry is, where did the miracle take place? And I do not well understand how Mr. Huxley, or his authorities, have so readily arrived at the conclusion that the very existence of any place named Gergesa is very questionable.* Origen was a learned man, of critical mind, and he resided for a large part of his life in Palestine, and traveled there only two centuries after the time of our Lord.† He tells us expressly these three things:

1. That there was an ancient city named Gergesa on the Lake of Tiberias.

2. That, bordering on the water, there was a precipitous descent, which it appears, or is proved (*δείκνυται*), that the swine descended.

3. That Gadara is indeed a city of Judæa, with very famous baths, but has no precipitous ground in the vicinity of water.‡

This statement from such a source, at such a date, appears to require a treatment much more careful than the dictum that the existence of Gergesa is "very questionable." I admit, however, my obligation under the circumstances to inquire also, and fully, into the case of Gadara.

Let me now summarily point out what I conceive to be the main sources of error, which, taken together, vitiate the entire argument of Prof. Huxley.

1. Throughout the paper he confounds together what I had

* Nineteenth Century, December, 1890, p. 972.

† See also McClellan's New Testament, on Matt. viii, 28, for the testimony of St. Jerome.

‡ Orig., Comment. in Joann., p. 145.

distinguished, namely, the city of Gadara and the vicinage attached to it, not as a mere *pomœrium*, but as a rural district.

2. He more fatally confounds the local civil government and its following, including, perhaps, the whole wealthy class and those attached to it, with the ethnical character of the general population.

3. His one item of direct evidence as to the Gentile character of the city refers only to the former and not to the latter.

4. He fatally confounds the question of political party with those of nationality and of religion, and assumes that those who took the side of Rome in the factions that prevailed could not be subject to the Mosaic law.

5. His examination of the text of Josephus is alike one-sided, inadequate, and erroneous.

6. Finally, he sets aside, on grounds not critical or historical, but purely subjective, the primary historical testimony on the subject, namely, that of the three Synoptic Evangelists, who write as contemporaries, and deal directly with the subject, neither of which is done by any other authority.

7. And he treats the entire question, in the narrowed form in which it arises upon secular testimony, as if it were capable of a solution so clear and summary as to warrant the use of the extremest weapons of controversy against those who presume to differ from him.

Our main question, then, is the lawfulness and innocence of the employment of the swineherds. The ethnical character of Gadara and of its district derives its interest from its relation to that main question. In my opinion, not formed without an attempt at full examination, there is no historical warrant for doubting that the swineherds were persons bound by the Mosaic law. In the opinion of Mr. Huxley,* "the proof that Gadara was, to all intents and purposes, a Gentile and not a Jewish city, is complete." And, again,† Gadara was, "for Josephus, just as much a Gentile city as Ptolemais." Utterly contesting these two propositions, I make two admissions: first, that one or more of the many and sparse references of Josephus may easily mislead a prepossessed and incomplete inquirer; and secondly, that in the territory of Gadara, and in various other parts of Palestine, it would be a mistake to look for a perfectly homogeneous population either Hebrew or Gentile.

Outside the text of Josephus, Prof. Huxley adduces but a single fact in support of his allegations concerning Gadara—the fact, namely, that its coinage was Gentile. But coinage is essentially, and is most of all in conquered a country, the work of the

* Nineteenth Century, p. 973. † Ibid., p. 974.

governors, wholly apart from the governed. To say that the Gadarenes "adopted the Pompeian era on their coinage,"* out of gratitude, must almost be a jest. If Pompey re-annexed Gadara to the Syrian province,† it is most improbable that he should have altered its laws respecting religion. Mr. Huxley supposes this change was popular as a restoration of Roman authority. But, had he consulted the text of Josephus, he would have seen it was approved, because the cities were restored by him to the "Home Rule" of their own proper inhabitants.

I. THE REVOLTED JEWS.—Mr. Huxley comes nearer to the point when he touches the text of Josephus,‡ on which, indeed, apart from the Synoptic Evangelists, we have chiefly to depend. He deals with the passages found in the 18th chapter of Book II of the Judaic War. Now, these passages are most dangerous and seductive to those of his opinion, because, if severed from other passages, they would prove his point: on one condition, however, namely this, that we admit what is, indeed, his master fallacy, to be sound in logic and in fact.

He says* that the revolted Jews are stated by Josephus to have laid waste the villages of the Syrians, "and their neighboring cities, and after them Gadara and Hippos." He then cites from Section 5 the passage which states that Scythopolis, Askelon, Ptolemais, and Tyre slew or put in prison great numbers of Jews. "Those of Hippos and those of Gadara did the like; as did the remaining cities of Syria." And hereupon Prof. Huxley assumes that his case is proved: *causa finita est.*

And so, perhaps, it might be were we to adopt what I have termed his master fallacy. That master fallacy is his assumption as to the cleavage of the Palestinian communities. According to him, all that was anti-Roman was Jewish or Hebrew, and all that acted on the other side was Gentile. Where, as in Tyre or Ptolemais, the population generally is known to have been Gentile, this assumption would, in the absence of evidence to the contrary, be a fair one. Such, in Mr. Huxley's view, was the case of Gadara, where the Jews were only local immigrants, like the inhabitants of a Ghetto.‖ But this is just what he ought to prove; and it is not proved by showing either that those Jews who were in revolt attacked a part of the Gadarite population, or that the Gadarite population afterward did the like to some Jews among themselves. For the whole text of Josephus testifies that the Jews, as often happens in a case where foreign domination exists over a people of high nationalism, were sharply divided among themselves on the point of resistance. There were among them

* Nineteenth Century, p. 973.
† Josephus, de Bell. Jud., i, 7, 7.
‡ Nineteenth Century, p. 974.
* Ibid. on Bell. Jud., ii, 18, 1.
‖ Nineteenth Century, p. 974.

Roman and anti-Roman factions; ardent spirits always disposed to rise, and spirits more sluggish and pacific, who were either indifferent or indisposed to run the risk. Further, the strife between these sometimes went to blood, and not unfrequently placed the same community on different sides at different times. This, undoubtedly, I have to prove. I will first illustrate it by various cases including even Jerusalem itself, and will afterward show that, if we wish to make sense and not nonsense out of Josephus, we must apply the same ideas to Gadara, which besides, in all likelihood, had some mixture of population, and classes possessed of wealth and influence, which were sure to take the Roman or anti-national side.

I must first, however, observe that Mr. Huxley has quoted the text of Josephus inaccurately. As he has cited it, the revolted Jews proceeded at Gadara and Hippos as they had done in the cities of Syria that he had previously mentioned. But what Josephus says* is that they devastated (wholesale as it were) these Syrian cities, and that then, proceeding against Gadara and Hippos (which meant territories and not mere cities), they burned some places, and reduced to submission (not the rest but) others; thus, pointing to those differences of local faction, class, or race, in the different neighborhoods, which Mr. Huxley overlooks.

Sepphoris, the chief city of Galilee, and the strongest, exhibits those anomalies of political position which belonged to a conquered, disturbed, and variously divided country. It was one of the five great Hebrew centers, which Gabinius chose to be the seats of Sanhedrims.† After the death of Herod, it was taken and destroyed by the Romans, and the population reduced to slavery. Subsequently it was repeopled. When Vespasian invaded Palestine, it asked and obtained from him a Roman garrison,‡ as it had also received Cestius Gallus with acclamations not long before.* Yet, nearly at the same period, and probably between these two occasions, when Josephus was engaged in preparing Galilee for defense, by fortifying at the proper points, he left Sepphoris to raise its own walls,‖ because while it was rich it was also zealous for the war. Later on, Sepphoris was required to give hostages to the Romans▲ at the very time when it was exposed to the jealousy and hostility of the Jews. Thus the same city, according to local fluctuations, was the partisan to-day of one side, to-morrow of the other. A clear comprehension of this shifting character in the local facts is vitally necessary for a sound judgment on the case before us.

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* Bell. Jud., ii, 18, 5.
† Antiq. xiv, 5, 4; Bell. Jud., i, 8, 5.
‡ Ibid.
* Ibid., ii, 18, 11.
‖ Ibid., ii., 20, 6.
▲ Vita, c. 8.

Again, Gamala,* on the Sea of Tiberias, adhered at this time to Rome; a little later we find it one of the last and most obstinate strongholds of Judaism against Vespasian.† Further, Gabara, as I shall presently show, exhibited similar variations.

In truth, as Milman‡ says, "every city was torn to pieces by little animosities; wherever the insurgents had time to breathe from the assaults of the Romans, they turned their swords against each other." It was in Jerusalem most of all that these bloody factions raged; they were exasperated by the arrival of strangers; the peace parties shed the blood of the warlike, and the war parties of the peaceful.* In truth, such had long been the condition of that city, that Vespasian wisely postponed the commencement of his operations for fear he should extinguish the local feuds, which, as he saw, were wasting the strength of the rebels, and should compel them to unite together.‖

It is, then, quite conceivable that when Josephus says the revolted Jews burned some places and subjugated or kept down others in Gadaris, he means to speak of places where the peace party, which might be Jewish or not Jewish, predominated; and when he says the Hippenes and the Gadarenes acted against the Jews, he probably means that the Jews of the war party were put down by antagonists averse to war, though of their own race, as much as, and even possibly more than, by Gentile portions of the population. This, I have said, is a conceivable opinion. But, in order to justify what I have said of the argument of Prof. Huxley, I must show that it is an opinion not only conceivable, but warranted, and even required, by a consideration of the whole evidence on the record. That is the best conclusion, which best meets all the points of the case. The conclusion reached by Prof. Huxley leaves Josephus in hopeless contradiction to himself.

For I shall now proceed to show that Gadara or Gadaris, first, was an important center of Jewish population, by which I mean population subject to the Mosaic law; secondly, was a recognized seat of Jewish military strength; and thirdly, according to Josephus himself, acknowledged the law of Moses as its local public law, and was bound to obey it.

II. THE ORDINANCE OF GABINIUS.—Mr. Huxley places great reliance on the "classical" work of Dr. Schürer,^ which treats of the history of the Jewish people in the time of our Lord. And certainly a high tribute to it is due from him, as it seems to have supplied nearly all his material for the history and character of Gadara; except, indeed, the exaggeration of the terms in which

* Vita, c. 11.

† Milman, Hist. Jews, ii, 280–4.

‡ Ibid., ii, 290.

* Milman, Hist. Jews, ii, 315 *seqq.*

‖ Ibid., ii, 305.

^ Geschichte des jüdischen Volks im Zeitalter Jesu Christi, Leipzig, 1886–'90.

he describes them. It may, perhaps, be questioned whether a work, of which one half bears dates so recent as 1889 and 1890, can yet have fully earned the title of a classical work. I do not, however, presume to question its ability and research. On the other hand, without detracting from its general character, I can not presume it to be precise and conclusive upon every one of those complicated local histories of Palestinian towns, among which Gadara has to be reckoned. Nor can I help embracing the opinion that he is (in the case before us) overfond of giving the go-by to a difficulty by altering the text of his authority, so as to make it conform to the view he has adopted. No less than five times,* upon this very limited subject, does he accept or propose this method of proceeding. At the same time, he altogether passes by phrases, and even passages, of Josephus. which are of real, and, in one or more cases, even of capital importance.

Let the reader test what I have said, in the first place, by reference to the weighty statement of the Jewish historian as to the Sanhedrims of Gabinius.

Soon after the conquest by Pompey, who had himself given proof of his moderation and regard for the religion of a conquered people, Gabinius became administrator of the Roman power; and he divided Palestine into five regions, for the purpose of administering the Jewish law in each of them, through an assembly of elders termed Sanhedrim; possibly also with a view to the easier and more effective collection of the Roman tribute.

Of these regions, according to the text as it stands, one had Gadara for its center; the others being Jerusalem, Sepphoris, Jericho, and Amathus. The measure, and the name of Gadara, are mentioned in two separate passages. Here we have to all appearance a pretty flat contradiction to the theory that Gadara was a Greek or a Gentile city. Accordingly, says Mr. Huxley,† Schürer has "pointed out" that what Gabinius really did was to lodge one of these (the Sanhedrims) in Gazara, "far away on the other side of the Jordan." Under this facile phrase of "pointing out" is signified the deliberate alteration of the text, which inconveniently asserts not only in two separate passages, but in two separate works,‡ that the place selected was not Gazara but Gadara. Without doubt any theory can be established with ease, if we are free thus to bend the original text into conformity with its demands. In this instance that text contains, as we shall see, a specific statement, which, as Mr. Huxley must have found if he had referred to Josephus, made it manifestly impossible that he could have written Gazara in these two places.

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* Antiq., xiii, 13, 5 (Schürer, ii, 91); ibid., xiv, 5, 4; Bell. Judd., i, 8, 5; ibid., iii, 7, 1; Vita, c. 15.

† Nineteenth Century, p. 973.

‡ Antiq., xiv, 5, 4; Bell. Judd., i, 8, 5.

I confess that Dr. Schürer appears to me to have seriously misapprehended in some degree the spirit of this measure as well as the facts, when he says * that it involved the abolition of whatever residue of political independence had thus long remained to Palestine, because Hyrcanus was now deprived of his temporal and confined to his priestly power. If we examine the matter according to the reason of the case, it was probably a great gain to the population to have the Mosaic law administered at its own doors by its own local leaders rather than by a priest-king sitting at a distance in Jerusalem. If we test it by the general spirit of the policy of this proconsul, we are led to suppose it friendly, because with it there was combined the rebuilding of some cities which had been overthrown. If we follow the authority of Josephus, we are bound to take it as a measure altogether favorable to Jewish liberties; for he says, † "thus the Jews were liberated from dynastic rule, and remained under the government of their local heads" (ἐν ἀριστοκρατείᾳ διῆγον).

Since the text, as it stands, entirely overthrows the doctrine that Gadara was a Gentile city, the propounders of that theory can only meet their difficulty by altering it, although they must surely feel that the contradiction of two independent works is a remedy not daring only, but rather desperate.

But, independently of the confirmatory witness of a double text, Josephus can not have written Gazara, for, if he had done so, he would have committed the absurd error of contradicting himself in the very sentence in which he wrote it.

Gazara is not only "far on the other side of Jordan." We are dealing with the northeast of the country, and Gazara is in the extreme southwest. Josephus says expressly that Gabinius divided the country into five *equal* districts. Now the old kingdom of Judæa may be taken roughly as one third of Palestine. Samaria was probably excluded: even if it were not, the case is not greatly altered. For the emendation thus "pointed out" entirely overthrows the equality of the districts. It gives to Judæa three out of the five Sanhedrims, and, leaving Amathus for the country beyond Jordan, assigns to Sepphoris alone the Galilees and Decapolis, or a territory about as large as that given to the three southern centers conjointly.

It can hardly be necessary to observe that, besides this fatal objection, Gazara seems to be disqualified by its geographical remoteness near the southwestern border, and perhaps also by comparative historical insignificance.

The emendation, then, has to be committed *emendaturis ignibus* for self-contradiction; and the twice-repeated testimony of Josephus stands intact, showing that, shortly after the time of

* Gesch., i, 276. † Antiq., xiv, 5, 4.

Pompey, Gadara was chosen for a purpose which obviously required, and which therefore establishes its being, a great center of Hebrew or Mosaic population.

III. MILITARY IMPORTANCE.—Having shown that Gadara was important as a center of population which was either Jewish in blood or governed by the Jewish law, I will next show that Gadara was also formidable as a seat of Jewish military power. The time came when Vespasian had to contemplate operations against Jerusalem. And now, says Josephus,* "it was necessary for him to subdue what remained unsubdued, and to leave nothing behind him which might prevent his prosecution of the siege."

Accordingly, he marched to the point of danger. This was Gadara, the strong metropolis of Peræa, which had once, against Jannæus, stood a siege of ten months. The rich, who were numerous there, escaping the notice of their opponents, had invited him. On the approach of Vespasian, the party disposed to war found itself (and no wonder) in a minority, and fled; but not till they had massacred Dolesus, the author of the invitation to the Roman general. In their absence, the people received Vespasian with acclamations. But they pulled down the walls of their own accord; and he then left with them a garrison of horse and foot to defend them against the return of the expelled party. Why were the walls pulled down, except to prevent the population from holding the city against the Romans? Why, although the wealthy and the local governing power was friendly, yet was a Roman garrison left behind, but because the dominant force in the city, apart from foreign intervention, was a Hebrew or anti-Roman, and not a Gentile, force? And does not this passage, even if it stood alone, abundantly suffice to show that, whatever the division of parties may have been, Gadara was not, "to all intents and purposes, a Gentile city"? It was a city from which Vespasian apprehended an attack in his rear; and to prevent this he makes it an open city, and leaves a force in it in order that his partisans might continue to have the upper hand.

But let us not suppose that these partisans were necessarily Gentiles. I must again press the proposition that the Jews of that era, or the population observing the Mosaic law, were largely divided into peace party and war party, and that we may find the peace party acting with the Gentiles against their fellow-countrymen, in order to avoid the alternative of war. I will now refer to a passage which shows this in a manner quite conclusive. Gischala† appears to have been a city of the extreme war party, though it, too, had partisans of peace. However, it broke away, and was in consequence assailed and destroyed by a composite force of Tyrians, Sogarenes, Gadarenes, and Gabarenes. It seems

* Bell. Jud., iv, 7, 3. † Josephus, Vita, c. x.

quite natural that the Tyrians, a Gentile people, should actively maintain the Roman domination. And the Gadarenes on this occasion acted with them. Shall this prove Gadara to be a Gentile city? Certainly not; for Gabara was a Galilæan, and, as Mr. Huxley sees, a thoroughly Jewish city, and yet it shared in the overthrow of Gischala. There can not be a clearer proof that, in certain cases, it was not the question of religion or race that determined the balance of opinion and the action of the community, but the question of war or peace. I rely, then, on the strategical movement of Vespasian to show that Gadara, an important center of Jewish population, was also in the main an important seat of Jewish military strength; most of all, perhaps, as being the center at which the rural population of Gadaris would muster for war in case of emergency.

IV. THE JEWISH LAW IN GADARIS.—Although, in inquiries of this kind, we may speak of Jewish or Hebrew populations, as Dean Milman does, to describe generally those who were adverse to the Roman power, the expressions are not quite satisfactory, because, in themselves, they involve a condition of race; whereas, to say nothing of those descendants of the ancient Canaanites who had conformed to Judaism, we find that the Mosaic law was imposed at the time of which we treat, as a consequence of conquest if not on Gentile yet on mixed populations. And the real question in respect to the Gadarene territory is not exclusively whether the population were of Hebrew extraction, but also, and indeed mainly, whether they were Jewish as being bound by the Jewish law: or, as I should like to call it, whether they were a Mosaic population. To this question let us now further look.

According to Origen,* Gadara was simply a city of Judæa. According to Josephus in one passage, it was a Grecian city, as were Hippos and Gaza.† But in another place he includes it in a great group of cities which were Syrian, Idumæan, or Phœnician,‡ and he then places it in the Syrian subdivision of that group. We are guided by the nature of the case to the meaning of these two last-named designations. There was no properly Hellenic element reckoned in the population of the country,* though there must have been a sprinkling of Greeks concerned in the administration of the kingdoms founded by Alexander's generals. As there were Phœnicians in the earliest Hellas, so now there were important Hellenic settlers in Asia, and, without doubt, a larger number of Hellenized Asiatics. In connection with the name of Gadaris, Strabo‖ enumerates a few Greek individuals of some distinction. The case has been sufficiently explained by Grote,^ who allows as the characteristics of what was, he thinks improp-

* In Joann., p. 141.
† Bell. Jud., ii, 6, 3.
‡ Antiq., xiii, 15, 4.
* Strabo, xvi, 2.
‖ Ibid., xvi, 2, 29.
^ Hist. of Greece, xii, 362–7.

erly, called Hellenism, in the kingdoms after Alexander, the common use of Greek speech, a certain proportion of Greeks, both as inhabitants and as officers, and a partial streak of Hellenic culture. The flavor of Hellenism would be found rather at central spots than in the country at large. At Gadara it might be sustained by the bath, which probably made it a place of fashionable resort. But in this qualified or diluted sense, the name of Grecian was applied both to the Syrian and the Egyptian powers,* and the Rescript of Augustus respecting religion accordingly describes Judæa as having suffered grievously from Greek cruelty. Politically, Gadara with Hippos and Gaza † were given to Herod, and after his death, on the division of his dominions, they were re-annexed to Syria. But these were administrative changes, without any effect, so far as appears, on the laws and religion of the country. Very different was the change which ensued when, from having been a Syrian city,‡ it was acquired by Alexander Jannæus for Judæa.* My opponent has overlooked the capital fact, that what Judæa acquired or recovered by conquest was thereupon placed under the Mosaic law. In Samaria, we may safely assume that it was there already when Jannæus conquered it. When Idumæa was subdued by his father Hyrcanus,‖ that law was established, and the people were at once circumcised. In the case now before us the statement, though indirect, is equally conclusive. When Josephus enumerates^ the cities conquered by Jannæus, Pella closes the list. But Pella, he adds, they destroyed, because the inhabitants would not submit to the Mosaic law (*τὰ πάτρια τῶν Ἰουδαίων ἔθη*). It is plain therefore that the other cities, of which Gadara was one, remained intact, because they allowed the law of Moses to become the law of the land.

Alexander Jannæus died in B. C. 79. But there is not, so far as I know, the smallest evidence that the law was altered here, any more than in Galilee or Judæa, before the time of our Saviour. Mr. Huxley indeed again and again assumes the contrary,◊ but without citing a single authority, or even taking notice of the testimony from Josephus which I have here given; and it is in the light of this passage that we have to consider the establishment of the Sanhedrim by Gibinius. He says, indeed (without any reference), that the only laws of Gadara were the Gentile laws sanctioned by the Roman suzerain.‡ Now we know some-

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* Antiq., xvi, 6, 2. † Bell. Jud., ii, 5, 3. Antiq., xvii, 11, 4.

‡ Mr. Huxley says, "It is said to have been destroyed by captors." It is not so stated by Josephus in his account of the conquest. But it seems to have undergone some reverse before the time of Pompey (B. C. 65), by whose favor it was restored.

* Antiq., xiii, 15, 4. ‖ Milman, Hist. Jews, ii, 28. Bell. Jud., xix, 9, 1.

^ Antiq., xiii, 15, 4. ◊ Nineteenth Century, pp. 977–8. ‡ Ibid., p. 977.

thing of the proceedings of the Roman suzerain in the time of Augustus, with regard to the Jews, not of Judæa merely, but of Asia at large and of Cyrenais, who appealed to Cæsar against what they termed Greek oppression.* The answer commends the fidelity of the Jews; it especially lauds Hyrcanus, the actual high priest; and then grants to the Jews without limit the full enjoyment of their own peculiar laws after the manner of their fathers as they were enjoying them under Hyrcanus, the high priest. This charter of continuance for the Mosaic law where it prevailed is issued during the lifetime of Herod the Great, and before the reannexation of Gadara to the Syrian province. I can hardly suppose, however, that any one would assign to that merely administrative change the effect of altering the religious law of the country, a matter in which the rule of Roman policy was that of resolute non-interference.

I conceive, then, that the conquest of Jannæus, together with the measures of Gabinius, leave no reasonable ground for doubting that the law established in Gadara at that period was the Mosaic law; and also that the Rescript of Augustus confirms this proposition. But confirmation is not required. If the religious system of the Jews was established there in the time of Gabinius, we must assume its continuance until we find it changed. Of such a change there is not, I believe, any sign before the time of our Lord.

V. STRABO.—Were it only on account of his general authority, we must not omit to notice the particulars which Strabo has supplied with respect to Gadaris. He has indeed fallen into undeniable confusion as to geographical arrangement, yet not so as to hide the real effect of some important statements.

In proceeding southward along the Syrian coast, Strabo† places Gadaris next to Joppa; then come Azotus, Ascalon, and Gaza. From Gadara proceeded five persons with Grecian names, of whom he gives a list. Now this Gadara has points of contact with the Gadara of the north, first because he speaks of it as Gadaris, a territory and not only a town; secondly, because the Greeks whom he names are known to have sprung from Gadara of Perræa.‡ Let us now try to clear up this matter.

Proceeding from Gaza toward Pelusium, he introduces the Sirbonian Lake or morass;* but in describing by characteristic details the nature of its waters, he gives them properties which, copied from Diodorus, render it an accurate account of the Dead Sea; except that he assigns to it only two hundred stadia in length, and makes it stretch along the sea-coast, which agrees with

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* Josephus, Antiq., xvi, 6, 1, 2.

† Strabo, xvi, 2, p. 759.

‡ Schürer, ii, 91.

* Strabo, 763.

the Sirbonian Lake, while the length of the Dead Sea nearly reaches forty miles.* He was in fact almost wholly ignorant of the interior; and, as he confounded the Dead Sea with the Sirbonian Lake, he probably also confounded the Lake of Tiberias with the Dead Sea, both being on the line of the Jordan; and thus was led to bring Gadaris into geographical relation with it and with the coast.

The chief importance, however, of his account is to be found in a third point of contact with the true Gadaris which it presents. He describes the appropriation of this territory by a remarkable phrase. The Jews, he says, *ἐξιδιάσαντο*, made it conform to their own model; thus supporting emphatically the account drawn above from Josephus respecting the introduction of the Jewish law into the district.

It seems possible that Strabo may have been in part misled by the name of Gazara, which was in this part of Palestine, and which had likewise been Judaized upon a military conquest.

VI. GADARA AND GABARA.—Vespasian, in commencing his campaign of A. D. 67, came from Antioch to Ptolemais to unite his force with that of Titus. He was there met by a party sent out of Sepphoris,† who obtained from him a Roman garrison. From this center, all Galilee was laid waste with fire and sword, there being no safety except in the cities fortified by Josephus.‡ Vespasian then carried his army of overwhelming force across the Galilæan frontier, and encamped there to try the moral effect upon the enemy. It was so powerful that Josephus,* who commanded the Jews, withdrew his force to Tiberias, at the extremity of the province.

Hereupon, says our historian,‖ Vespasian attacked the city of the Gadarenes, took it at the first assault, as it was not provided with a fighting force, and on his entry slaughtered the inhabitants of military age, for two reasons—one of which was hatred to their race. As the text stands, it proves at least a wide prevalence of Jewish nationality in the city and region of Gadaris.

It is proposed, however, to alter Gadara into Gabara, and the alteration, first suggested by Reland (1714), but not adopted by Hudson (1720) or Cardwell (1837), has received the approval of Schürer, of Milman,^ and of Robinson.◊ I speak of it with respect, out of deference to such authorities. They do not seem to have stated conclusive or even detailed reasons, beyond the remark that, while Gabara may be within fifteen miles of Ptolemais, Gadara is out of Galilee, and more than twice the distance. Prof.

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* Williams in Smith's Dictionary.
† Bell. Jud., ii, 2, 4.
‡ Ibid., 4, 1.
* Ibid., 6, 2, 3.
‖ Ibid., 7, 1.
^ ii, 243.
◊ Biblical Researches, iv, 37.

Huxley has gone much further, and has set forth strategical reasons which he thinks demonstrate that Vespasian's case would have been one truly of demoniacal possession could he have passed by Gabara and marched on to Gadara. For the Roman line of march would have been between Gabara, to the north, and Jotopata, a fortified city in strong position on the south. According to Robinson,* I may observe the distance between the two is only from six to eight Roman miles. Vespasian "could not afford to leave these strongholds in the possession of the enemy,"† and from Gabara "his communications with his base could easily be threatened."

Now this statement is contradicted right and left by the facts. For first, if Gabara be the right reading, it was (and so Milman has stated it) ungarrisoned. Secondly, it was not a stronghold at all; for Josephus tells us that all Galilee was now cruelly devastated with fire and sword by the Romans, and there was nowhere any refuge, except in the cities he had fortified; of which Gabara was not one. Thirdly, in the narrow region between Gabara and Jotopata lay Sepphoris, which was held by the Romans, and was the stronghold from which all Galilee was laid waste. Fourthly, Vespasian, in defiance of his modern instructor, did leave behind him all the twelve or fourteen strong places that Josephus had fortified except one. Fifthly, he did, indeed, march against Jotopata, but for this he had a very strong reason, quite apart from fears about his base, which would under the circumstances have been chimerical; namely, that the Roman commander, Placidus, had just before failed in an attack upon it, and had been defeated and put to flight under its walls. We may now, I think, bid adieu to the strategy of Prof. Huxley.

Many a good cause, however, suffers from the use of bad arguments in its favor. It remains for me to offer, with due submission some reasons, which appear to me serious, in support of the text as it stands.

1. Josephus says Vespasian attacked "the city of the Gadarenes." So far as I know, he uses this form of expression only when the city is the center of a district (Gadaris),‡ named after it. Such was the case of Gadara, but not of Gabara. He does not call Sepphoris the city of the Sepphorites, or Gamala the city of the Gamalenes.

2. He says the place was taken at the first assault; appropriately enough for a fortified place shorn of its garrison, but not appropriate for an open town.

3. Gamala, as part of the open country of Galilee, was already in full subjection to the Romans.

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* Biblical Researches, iv, 87 (1852). † Nineteenth Century, p. 976. ‡ Bell. Jud., iii, 3, 1.

4. If, as we see, Vespasian began his operations by securing Sepphoris, the capital of Galilee, and thereby secured the province, so that the Jewish force fled to Tiberias, was it strange or unnatural that he should as his next operation secure the capital of Peræa to dominate the territory beyond Jordan?

5. The text, as it stands, agrees with Book iv, 7, 3, in testifying to the military importance of Gadara: but the emendation makes Vespasian prefer to Jotopata a place which apparently counted for nothing in military movements.

VII. TESTIMONY OF THE EVANGELISTS.—Bidding farewell now to the text of Josephus, I do not know that we have much more assistance to expect from secular literature as to Gadara and its district. But a very important light is cast upon it by the Synoptical Gospels, and by the facts of the Old Testament history in their relation to the geographical precinct, which was also in general the ethnical limit, of our Lord's ministry upon earth.

It was, apparently, a part of the providential calling of the race of Abraham that they were to have in the first instance for themselves a distinct and separate offer of the new "glad tidings." Christ was not sent, accordingly, "but to the lost sheep of the House of Israel." It is most interesting to observe how and in what localities this offer took effect.

We naturally look in the first instance to Jerusalem and the country belonging to it. Our Lord was born, as we know, in Judæa; and the scene of the Gospel of St. John, which is in the main confined to Jerusalem and its neighborhood, and also in the main to a few continuous narratives, is principally laid there. The territory of Samaria was immediately contiguous to that of Judæa, but "the Jews had no dealings"* with the mixed race inhabiting that country, and our Saviour seems never to have exercised there more than what may be termed an accidental ministry. But the Baptism and temptation were in Galilee.† It was there that He commenced His course of miracles.‡ When the wakeful jealousy of the Pharisees made it needful for Him to quit Judæa and repair to Galilee,* "He must needs go through Samaria." Then came the (so to speak) casual meeting and discourse with the woman of Samaria, to whom He declared that salvation was of the Jews.‖ Out of the report which she carried away from Him, there grew an invitation of the Samaritans to the Saviour, praying Him to come among them:^ but He abode with them only two days, and passed on into Galilee. It is wonderful to observe how large a proportion of His ministry was ex-

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* John iv, 9.
† Matt. iii, 1, 13; iv, 1.
‡ John ii, 11.
* Ibid., i, 43; ii, 1-11.
‖ Ibid., v, 22.
^ Ibid., v, 40.

ercised in the north. Nor was it in the neighborhood of His own city of Nazareth, nor equally diffused over the Galilæan provinces from east to west, but was almost confined, or most largely given, to the eastern district and the close neighborhood of the Galilæan sea. Here and hereabouts we have the principal specific narratives of the calling of the Apostles,* to the number, apparently, of six. Here lay the chief scene of our Lord's active ministry: here was delivered the Sermon on the Mount. It was not only from the eastern or Galilæan side of this sea, but from Decapolis also He was followed by great multitudes;† and of Decapolis Gadara and its district were an important, and were also the nearest, part. And the fact that our Saviour selected Chorazin, Bethsaida, and Capernaum for the denunciation of the woes,‡ on account of the privileges that they had enjoyed, at once denotes the scenes of His habitual preaching, and bears appalling testimony to its rejection. Dr. Edersheim places a group of the miracles to the east of the sea of Galilee in "a semi-heathen population,"* lying much beyond Gadara. But he includes the eastern shores of the lake in the country which he describes as the principal seat of Jewish nationalism.‖ This perhaps was "Galilee of the Gentiles."△ Nor did our Lord wholly avoid the coasts of Tyre and Sidon,◊ where there were Jews in considerable numbers: but the contrast between these towns and those before named proves the comparative rarity of His visits. If they were also rare in Decapolis, "through the midst of the coasts of which"‡ He came, we must recollect that this district, constituted under Greek authority, included Damascus and other Gentile cities. We know very well that Hebraic settlement and influence were not in our Lord's time confined to the western side of the Lake of Tiberias; for the town of Gamala‡ on its eastern side (see Robinson's map) was sternly Jewish in the final struggle, which was also sustained by multitudes, so says Josephus, from Peræa as well as other parts of Palestine; Peræa being regularly reckoned as part of Palestine by the Rabbis.‡

We need not doubt that there was a variable Syrian infusion in the population of this country. But we have to bear in mind that Gadaris and all its neighborhood formed part of the old promised land, and that, accordingly, the law of Moses had been in force there from a date running back fifteen hundred years; except, perhaps, at the comparatively recent period at which it had been reckoned for a time as a Syrian city. The right general

* Matt. iv, 18–22, and John i, 40–51.
† Matt. iv, 25.
‡ Ibid., xi, 21–24; Luke x, 13–15.
* Life and Times of Jesus, ch. xxxiv.
‖ Ibid., ch. x, vol. i, p. 238.
△ Matt. iv, 15; Isaiah ix, 1.
◊ Matt. xv, 21; Mark vii, 24.
‡ Mark vii, 31.
‡ Milman, Hist. Jews, ii, 280–6.
‡ Edersheim, i, 398.

assumption, therefore, is that the large majority, especially of the rural and laboring population, was either of genuinely Hebrew origin, or was drawn from one of those nations of Canaan who were in prior occupation. As to these, the reader of the Sacred Volume must be struck by the contrast between the pre-exilic and the post-exilic times. In the earlier history of Palestine, we are only too much reminded of their presence by the fatal fascinations of their worship. At the later period, when Judaism had set itself firmly against idolatry, they seem to be effaced; and we are left to infer that unless in Samaria, on which they imprinted a hybrid character, they had either quitted the country or had been drawn gradually within the compass of the more substantive religion, and had come to be reckoned in the number of the dominant and stronger race. Over and above these considerations, and that re-establishment of the Jewish law in the recovered cities, of which notice has already been taken, it is known that, after the two captivities, there was a powerful reflux or reaction of the Hebrew element or race in Northern Palestine, which, perhaps, was the means of establishing the broad distinction between it and Samaria. Dean Milman notices this infusion.* Samaria remained, he observes, in comparative insignificance. But the north became gradually populous, whether from the multiplication of those who had escaped deportation, or from those who returned, with the aid, perhaps, of families belonging to the southern tribes of Judah and Benjamin. We might have expected it partially to repair to the neighboring district of Samaria, and to the temple on Mount Gerizim; but, on the contrary, the inhabitants worshiped in Jerusalem, followed the fortunes of its ruling power, and fought desperately at the close for the national cause. He speaks in particular of the two Galilees, but the resistance, as Dr. Edersheim has stated, extended beyond them, and it is plain that in a portion, at least, and evidently the nearer portion, of Decapolis strong nationalism prevailed. And here we may admire the wisdom of Gabinius in providing at Gadara and Sepphoris for the local administration of the law, and thus relieving this great population from much of the inconvenience of dependence on a distant center at Jerusalem.

Quite apart from the conclusive testimony of Josephus, Mr. Huxley has evidently seen that the Synoptical Gospels, in the narrative of the swine, and in other parts, presuppose the predominance of a Hebrew nationality in the population of Gadaris. He is wise, therefore, in not only rejecting the story, but availing himself of the occasion in order to challenge the general authority of the Gospels. Conversely, all we who acknowledge their

* Edersheim, i, 441, 2.

historical credit, must feel how improbable it is that our Lord should have carried His ministry into a really Greek or Gentile district on the only one occasion when He thought fit to run counter to the public sentiment, and to give to His action the character of a serious interference with the rights of property. How could He have ventured thus to associate Himself with the destruction of a great herd of swine, if the country was Gentile, and if those swine belonged to persons not bound by the prohibition of the Mosaic law? Might they not, and would they not, have resorted to the use of force against this unarmed as well as unauthorized intruder? But what happens is that the swineherds fly; according to all the three Evangelists, they fly; to the city, according to St. Matthew and St. Mark,* which was the seat of authority; and they tell what had happened. Why, then, if this was a land of Gentile rule, and if the swineherds were Gentiles, why was not our Saviour—since His agency was recognized—either assailed by popular violence, or called regularly to account by the law of the land; by that "Hellenic Gadarene law," † with the supposed existence of which Mr. Huxley pastures his imagination? Instead of this, without the slightest idea of an accusation against our Lord, the population, streaming forth, simply consult for their own temporal interests, and beseech Him to depart out of their coasts.‡

The supply of swine testifies indeed to the existence of a demand. It may probably testify also to the existence of a Gentile class or element in the country. The question, indeed, which relates to the use of pork as an article of diet has by no means that uniformity of color, outside the Mosaic law, which Prof. Huxley assigns to it. But it would be tedious by entering upon it to lengthen a paper already too long, for we may safely allow that among the Syrian Gentiles this diet may have been known, and may not have entailed any legal penalty.

Mr. Huxley concludes the argumentative portion of his article by insisting that the "party of Galilæans" ⁸ were foreigners in the Decapolis, and could have no title, as private individuals, even to vindicate the law. I will not argue the point, which is wholly immaterial to my purpose; and it may not be easy to draw with exactness the line up to which the private person may go of his own motion in supporting established law. I confine myself to the following propositions:

1. Both from antecedent likelihoods, and from history, there is the strongest reason to believe that the Mosaic law was the public law of Gadaris.

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* Matt. viii, 34; Mark v, 13.

† Nineteenth Century, p. 976.

‡ Matt. viii, 34; Mark v, 17; Luke viii, 37.

⁸ Nineteenth Century, p. 978.

2. Even if it had been relaxed as public law, yet those traditionally bound to it would not have been released from the moral obligation of obedience, and all the particulars go to show that the keepers of the swine were thus bound.

3. In the enforcement of a law which bound the conscience, our Lord had an authority such as does not belong to the private individual.

4. That the Gadarenes should have deprecated any recurrence of this interference with unlawful gains, is no more wonderful than that the population of the maritime counties of Great Britain should, in the days of our protective tariff, have been favorable to smuggling, and should even have resented, as they did, the interference of conscientious clergymen whose duty it was to denounce the practice.

5. That they should have done no more than ask for our Saviour's departure, affords of itself the strongest presumption that the action in which He co-operated, and which was certainly detrimental, was not illegal.

I submit these observations upon an historical subject, complicated by several difficulties, with all respect to those who differ from me. I do not deny that the population of Decapolis was in some sense a mixed population, partially resembling that of Samaria.* But to suppose the swineherds to have been punished by Christ for pursuing a calling which to them was an innocent one, is to run counter to every law of reasonable historic interpretation. I will not assume that I have even now exhausted the subject, though I have not knowingly omitted anything material. But Prof. Huxley is so well pleased with his own contentions, that he thinks the occasion one suitable for pointing out the intellectual superiority to which he has been led up by scientific training. I believe that I have overthrown every one of them; but I do not think the achievement such as would warrant my concluding by paying myself a compliment.—*Nineteenth Century.*

MR. FRANCIS GALTON exhibited at a recent meeting of the Anthropological Institute a number of impressions of the bulbs of the thumb and fingers of human hands, showing the curves of the papillary ridges on the skin. These impressions are an unfailing mark of the identity of a person, since they do not vary from youth to age, and are different in different individuals. Impressions of the thumb formed a kind of oath or signature among the Chinese, but were not used by them as proofs of identity. Sir W. J. Herschel, when in the Bengal civil service, introduced the practice of imprinting finger-marks as a check on personation. In Mr. Galton's impressions, which were taken from more than two thousand persons, typical forms can be discerned and traced, of which the individual forms are mere varieties. Wide departures from the typical forms are very rare.

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* Bell. Jud., iii, 3, 2.

ILLUSTRATIONS OF MR. GLADSTONE'S CONTROVERSIAL METHOD.

By Prof. T. H. HUXLEY.

THE series of essays in defense of the historical accuracy of the Jewish and Christian Scriptures contributed by Mr. Gladstone to Good Words, having been revised and enlarged by their author, appeared last year as a separate volume, under the somewhat defiant title of The Impregnable Rock of Holy Scripture.

The last of these essays, entitled Conclusion, contains an attack, or rather several attacks, couched in language which certainly does not err upon the side of moderation or of courtesy, upon statements and opinions of mine. One of these assaults is a deliberately devised attempt, not merely to rouse the theological prejudices ingrained in the majority of Mr. Gladstone's readers, but to hold me up as a person who has endeavored to besmirch the personal character of the object of their veneration. For Mr. Gladstone asserts that I have undertaken to try "the character of our Lord" (p. 268); and he tells the many who are, as I think, unfortunately, predisposed to place implicit credit in his assertions, that it has been reserved for me to discover that "Jesus was no better than a law-breaker and an evil-doer!" (p. 269).

It was extremely easy for me to prove, as I did in the pages of this Review last December, that, under the most favorable interpretation, this amazing declaration must be ascribed to extreme confusion of thought. And, by bringing an abundance of goodwill to the consideration of the subject, I have now convinced myself that it is right for me to admit that a person of Mr. Gladstone's intellectual acuteness really did mistake the reprobation of the course of conduct ascribed to Jesus, in a story of which I expressly say I do not believe a word, for an attack on his character and a declaration that he was "no better than a law-breaker and evil-doer." At any rate, so far as I can see, this is what Mr. Gladstone wished to be believed when he wrote the following passage:

> I must, however, in passing, make the confession that I did not state with accuracy, as I ought to have done, the precise form of the accusation. I treated it as an imputation on the action of our Lord; he replies that it is only an imputation on the narrative of three evangelists respecting Him. The difference, from his point of view, is probably material, and I therefore regret that I overlooked it.*

Considering the gravity of the error which is here admitted, the fashion of the withdrawal appears more singular than admi-

* Nineteenth Century, February, 1891, pp. 339, 340. [Popular Science Monthly, August, 1891, p. 502.]

rable. From my "point of view"—not from Mr. Gladstone's apparently—the little discrepancy between the facts and Mr. Gladstone's carefully offensive travesty of them is "probably" (only "probably") material. However, as Mr. Gladstone concludes with an official expression of regret for his error, it is my business to return an equally official expression of gratitude for the attenuated reparation with which I am favored.

Having cleared this specimen of Mr. Gladstone's controversial method out of the way, I may proceed to the next assault, that on a passage in an article on Agnosticism (Nineteenth Century, February, 1889),* published two years ago. I there said, in referring to the Gadarene story, "Everything I know of law and justice convinces me that the wanton destruction of other people's property is a misdemeanor of evil example." On this, Mr. Gladstone, continuing his candid and urbane observations, remarks (Impregnable Rock, p. 273) that, "exercising his rapid judgment on the text," and "not inquiring what anybody else had known or said about it," I had missed a point in support of that "accusation against our Lord" which he has now been constrained to admit I never made.

The "point" in question is that "Gadara was a city of Greeks rather than of Jews, from whence it might be inferred that to keep swine was innocent and lawful." I conceive that I have abundantly proved that Gadara answered exactly to the description here given of it; and I shall show, by and by, that Mr. Gladstone has used language which, to my mind, involves the admission that the authorities of the city were not Jews. But I have also taken a good deal of pains to show that the question thus raised is of no importance in relation to the main issue.† If Gadara was, as I maintain it was, a city of the Decapolis, Hellenistic in constitution and containing a predominantly Gentile population, my case is superabundantly fortified. On the other hand, if the hypothesis that Gadara was under Jewish government, which Mr. Gladstone seems sometimes to defend and sometimes to give up, were accepted, my case would be nowise weakened. At any rate, Gadara was not included within the jurisdiction of the tetrarch of Galilee; if it had been, the Galileans who crossed over the lake to Gadara had no official status; and they had

* [Popular Science Monthly, April, 1889.]

† Neither is it of any consequence whether the locality of the supposed miracle was Gadara, or Gerasa, or Gergesa. But I may say that I was well acquainted with Origen's opinion respecting Gergesa. It is fully discussed and rejected in Riehm's Handwörterbuch. In Kitto's Biblical Cyclopædia (II, p. 51) Prof. Porter remarks that Origen merely "conjectures" that Gergesa was indicated; and he adds: "Now, in a question of this kind, conjecture can not be admitted. We must implicitly follow the most ancient and credible testimony, which clearly pronounces in favor of Γαδαρηνῶν. This reading is adopted by Tischendorf, Alford, and Tregelles."

no more civil right to punish law-breakers than any other strangers.

In my turn, however, I may remark that there is a "point" which appears to have escaped Mr. Gladstone's notice. And that is somewhat unfortunate, because his whole argument turns upon it. Mr. Gladstone assumes, as a matter of course, that pig-keeping was an offense against the "law of Moses"; and, therefore, that Jews who kept pigs were as much liable to legal pains and penalties as Englishmen who smuggle brandy (Impregnable Rock, p. 274).

There can be no doubt that, according to the law, as it is defined in the Pentateuch, the pig was an "unclean" animal, and that pork was a forbidden article of diet. Moreover, since pigs are hardly likely to be kept for the mere love of those unsavory animals, pig-owning, or swineherding, must have been, and evidently was, regarded as a suspicious and degrading occupation by strict Jews, in the first century A. D. But I should like to know on what provision of the Mosaic law, as it is laid down in the Pentateuch, Mr. Gladstone bases the assumption, which is essential to his case, that the possession of pigs and the calling of a swineherd were actually illegal? The inquiry was put to me the other day; and, as I could not answer it, I turned up the article "Schwein" in Riehm's standard Handwörterbuch, for help out of my difficulty; but unfortunately without success. After speaking of the martyrdom which the Jews, under Antiochus Epiphanes, preferred to eating pork, the writer proceeds:

> It may be, nevertheless, that the practice of keeping pigs may have found its way into Palestine in the Græco-Roman time, in consequence of the great increase of the non-Jewish population; yet there is no evidence of it in the New Testament; the great herd of swine, two thousand in number, mentioned in the narrative of the possessed, was feeding in the territory of Gadara, which belonged to the Decapolis; and the prodigal son became a swineherd with the native of a far country into which he had wandered; in neither of these cases is there reason for thinking that the possessors of these herds were Jews.*

Having failed in my search, so far, I took up the next work of reference at hand, Kitto's Cyclopædia (vol. iii, 1876). There, under "Swine," the writer, Colonel Hamilton Smith, seemed at first to give me what I wanted, as he says that swine "appear to have been repeatedly introduced and reared by the Hebrew

* I may call attention, in passing, to the fact that this authority, at any rate, has no sort of doubt of the fact that Jewish law did not rule in Gadara (indeed, under the head of "Gadara," in the same work, it is expressly stated that the population of the place consisted "predominantly of heathens"), and that he scouts the notion that the Gadarene swineherds were Jews.

people,* notwithstanding the strong prohibition in the law of Moses (Isaiah lxv, 4"). But, in the first place, Isaiah's writings form no part of the "law of Moses"; and, in the second place, the people denounced by the prophet in this passage are neither the possessors of pigs, nor swineherds, but those "which eat swine's flesh and broth of abominable things is in their vessels." And when, in despair, I turned to the provisions of the law itself, my difficulty was not cleared up. Leviticus xi, 8 (Revised Version) says, in reference to the pig and other unclean animals: "Of their flesh ye shall not eat, and their carcasses ye shall not touch." In the revised version of Deuteronomy xiv, 8, the words of the prohibition are identical, and a skillful refiner might possibly satisfy himself, even if he satisfied nobody else, that "carcass" means the body of a live animal as well as of a dead one; and that, since swineherds could hardly avoid contact with their charges, their calling was implicitly forbidden.† Unfortunately, the authorized version expressly says "dead carcass"; and thus the most rabbinically minded of reconcilers might find his casuistry foiled by that great source of surprises, the "original Hebrew." That such check is at any rate possible, is clear from the fact that the legal uncleanness of some animals, as food, did not interfere with their being lawfully possessed, cared for, and sold by Jews. The provisions for the ransoming of unclean beasts (Leviticus xxvii, 27) and for the redemption of their sucklings (Numbers xviii, 15) sufficiently prove this. As the late Dr. Kalisch has observed in his Commentary on Leviticus, Part II, p. 129, note:

> Though asses and horses, camels and dogs, were kept by the Israelites, they were, to a certain extent, associated with the notion of impurity; they might be turned to profitable account by their labor or otherwise, but in respect to food they were an abomination.

The same learned commentator (*loc. cit.*, p. 88) proves that the Talmudists forbade the rearing of pigs by Jews, unconditionally and everywhere; and even included it under the same ban as the study of Greek philosophy, "since both alike were considered to lead to the desertion of the Jewish faith." It is very possible, indeed probable, that the Pharisees of the fourth decade of our first century took as strong a view of pig-keeping as did their spiritual descendants. But, for all that, it does not follow that the practice was illegal. The stricter Jews could not have despised and hated swineherds more than they did publicans; but,

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* The evidence adduced, so far as post-exile times are concerned, appears to me insufficient to prove this assertion.

† Even Leviticus xi, 26, cited without reference to the context, will not serve the purpose; because the swine *is* "cloven-footed" (Lev. xi, 7).

so far as I know, there is no provision in the law against the practice of the calling of a tax-gatherer by a Jew. The publican was in fact very much in the position of an Irish process-server at the present day—more, rather than less, despised and hated on account of the perfect legality of his occupation. Except for certain sacrificial purposes, pigs were held in such abhorrence by the ancient Egyptians that swineherds were not permitted to enter a temple, or to intermarry with other castes; and any one who had, even accidentally, touched a pig was unclean. But these very regulations prove that pig-keeping was not illegal; it merely involved certain civil and religious disabilities. For the Jews, dogs were typically "unclean" animals; but, when that eminently pious Hebrew, Tobit, "went forth" with the angel "the young man's dog" went "with them" (Tobit v, 16) without apparent remonstrance from the celestial guide. I really do not see how an appeal to the law could have justified any one in drowning Tobit's dog, on the ground that his master was keeping and feeding an animal quite as "unclean" as any pig. Certainly the excellent Raguel must have failed to see the harm of dog-keeping, for we are told that, on the travelers' return homeward, "the dog went after them" (xi, 4).

Until better light than I have been able to obtain is thrown upon the subject, therefore, it is obvious that Mr. Gladstone's argumentative house has been built upon an extremely slippery quicksand; perhaps even has no foundation at all.

Yet another "point" does not seem to have occurred to Mr. Gladstone, who is so much shocked that I attach no overwhelming weight to the assertions contained in the synoptic Gospels, even when all three concur. These Gospels agree in stating, in the most express, and, to some extent verbally identical, terms, that the devils entered the pigs at their own request,* and the third Gospel (viii, 31) tells us what the motive of the demons was in asking the singular boon: "They entreated him that he would not command them to depart into the abyss." From this, it would seem that the devils thought to exchange the heavy punishment of transportation to the abyss, for the lighter penalty of imprisonment in swine. And some commentators, more ingenious than respectful to the supposed chief actor in this extraordinary fable, have dwelt, with satisfaction, upon the very unpleasant quarter of an hour which the evil spirits must have had, when the headlong rush of their maddened tenements convinced them how completely they were taken in. In the whole story, there is not one

* First Gospel: "And the devils *besought him* saying, If thou cast us out send us away *into* the herd of swine." Second Gospel: "They *besought him* saying, Send us *into* the swine." Third Gospel: "They *entreated him* that he would give them leave to enter *into* them."

solitary hint that the destruction of the pigs was intended as a punishment of their owners, or of the swineherds. On the contrary, the concurrent testimony of the three narratives is to the effect that the catastrophe was the consequence of diabolic suggestion. And, indeed, no source could be more appropriate for an act of such manifest injustice and illegality.

I can but marvel that modern defenders of the faith should not be glad of any reasonable excuse for getting rid of a story which, if it had been invented by Voltaire, would have justly let loose floods of orthodox indignation.

Thus, the hypothesis to which Mr. Gladstone so fondly clings finds no support in the provisions of the "law of Moses" as that law is defined in the Pentateuch; while it is wholly inconsistent with the concurrent testimony of the synoptic Gospels, to which Mr. Gladstone attaches so much weight. In my judgment, it is directly contrary to everything which profane history tells us about the constitution and the population of the city of Gadara; and it commits those who accept it to a story which, if it were true, would implicate the founder of Christianity in an illegal and inequitable act.

Such being the case, I consider myself excused from following Mr. Gladstone through all the meanderings of his late attempt to extricate himself from the maze of historical and exegetical difficulties in which he is entangled. I content myself with assuring those who, with my paper (not Mr. Gladstone's version of my arguments) in hand, consult the original authorities, that they will find full justification for every statement I have made. But in order to dispose those who can not, or will not, take that trouble, to believe that the proverbial blindness of one that judges his own cause plays no part in inducing me to speak thus decidedly, I beg their attention to the following examination, which shall be as brief as I can make it, of the seven propositions in which Mr. Gladstone professes to give a faithful summary of my "errors."

When, in the middle of the seventeenth century, the Holy See declared that certain propositions contained in the works of Bishop Jansen were heretical, the Jansenists of Port Royal replied that, while they were ready to defer to the Papal authority about questions of faith and morals, they must be permitted to judge about questions of fact for themselves; and that, really, the condemned propositions were not to be found in Jansen's writings. As everybody knows, his Holiness and the Grand Monarque replied to this surely not unreasonable plea after the manner of Lord Peter in the Tale of a Tub. It is, therefore, not without some apprehension of meeting with a similar fate, that I put in a

like plea against Mr. Gladstone's Bull. The seven propositions declared to be false and condemnable, in that kindly and gentle way which so pleasantly compares with the authoritative style of the Vatican (No. 5 more particularly), may or may not be true. But they are not to be found in anything I have written. And some of them diametrically contravene that which I have written. I proceed to prove my assertion:

PROP. 1. *Throughout the paper he confounds together what I had distinguished, namely, the city of Gadara and the vicinage attached to it, not as a mere pomœrium, but as a rural district.*

In my judgment, this statement is devoid of foundation. At p. 972 of my paper on The Keepers of the Herd of Swine I point out, at some length, that, "in accordance with the ancient Hellenic practice," each city of the Decapolis must have been "surrounded by a certain amount of territory amenable to its jurisdiction"; and, to enforce this conclusion, I quote what Josephus says about the "villages that belonged to Gadara and Hippos." As I understand the term *pomerium* or *pomœrium*,* it means the space which, according to Roman custom, was kept free from buildings, immediately within and without the walls of a city; and which defined the range of the *auspicia urbana*. The conception of a *pomœrium* as a "vicinage attached to" a city, appears to be something quite novel and original. But then, to be sure, I do not know how many senses Mr. Gladstone may attach to the word "vicinage."

Whether Gadara had a *pomœrium*, in the proper technical sense, or not, is a point on which I offer no opinion. But that the city had a very considerable "rural district" attached to it, and, notwithstanding its distinctness, amenable to the jurisdiction of the Gentile municipal authorities, is one of the main points of my case.

PROP. 2. *He more fatally confounds the local civil government and its following, including, perhaps, the whole wealthy class and those attached to it, with the ethnical character of the general population.*

Having survived confusion No. 1, which turns out not to be on my side, I am now confronted in No. 2 with a "more fatal" error—and so it is, if there be degrees of fatality; but, again, it is Mr. Gladstone's and not mine. It would appear from this proposition (about the grammatical interpretation of which, however, I admit there are difficulties), that Mr. Gladstone holds that the "local civil government and its following among the wealthy," were ethnically different from the "general population." On p. 348, he further admits that the "wealthy and the local govern-

* See Marquardt, Römische Staatsverwaltung, Bd. III, p. 408.

ing power" were friendly to the Romans. Are we then to suppose that it was the persons of Jewish "ethnical character" who favored the Romans, while those of Gentile "ethnical character" were opposed to them? But if that supposition is absurd, the only alternative is that the local civil government was ethnically Gentile. That is exactly my contention.

At pp. 973 and 976 of the Keepers of the Herd of Swine I have fully discussed this question of the ethnical character of the general population. I have shown that, according to Josephus, who surely ought to have known, Gadara was as much a Gentile city as Ptolemais; I have proved that he includes Gadara among the cities "that rose up against the Jews that were among them," which is a pretty definite expression of his belief that the "ethnical character of the general population" was Gentile. There is no question here of Jews of the Roman party fighting with Jews of the Zealot party, as Mr. Gladstone suggests. It is the non-Jewish and anti-Jewish general population which rises up against the Jews who had settled "among them."

PROP. 3. *His one item of direct evidence as to the Gentile character of the city refers only to the former and not to the latter.*

More fatal still. But, once more not to me. I adduce not one, but a variety of "items" in proof of the non-Judaic character of the population of Gadara: the evidence of history; that of the coinage of the city; the direct testimony of Josephus, just cited—to mention no others. I repeat, if the wealthy people and those connected with them—the "classes" and the "hangers on" of Mr. Gladstone's well-known taxonomy—were, as he appears to admit they were, Gentiles; if the "civil government" was in their hands, as the coinage proves it was—what becomes of Mr. Gladstone's original proposition in The impregnable Rock of Scripture that "the population of Gadara, and still less (if less may be) the population of the neighborhood," were "Hebrews bound by the Mosaic law"? And what is the importance of estimating the precise proportion of Hebrews who may have resided, either in the city of Gadara, or in its dependent territory, when, as Mr. Gladstone now seems to admit (I am careful to say "seems"), the government, and consequently the law which ruled in that territory and defined civil right and wrong, was Gentile and not Judaic? But perhaps Mr. Gladstone is prepared to maintain that the Gentile "local civil government" of a city of the Decapolis administered Jewish law; and showed their respect for it, more particularly, by stamping their coinage with effigies of the emperors.

In point of fact, in his haste to attribute to me errors which I have not committed, Mr. Gladstone has given away his case.

PROP. 4. *He fatally confounds the question of political party with those of nationality and of religion, and assumes that those who*

took the side of Rome in the factions that prevailed could not be subject to the Mosaic law.

It would seem that I have a féline tenacity of life; once more, a "fatal" error. But Mr. Gladstone has forgotten an excellent rule of controversy: say what is true, of course, but mind that it is decently probable. Now it is not decently probable, hardly indeed conceivable, that any one who has read Josephus, or any other historian of the Jewish war, should be unaware that there were Jews (of whom Josephus himself was one), who "Romanized" and, more or less openly, opposed the war party. But, however that may be, I assert that Mr. Gladstone neither has produced, nor can produce, a passage of my writing which affords the slightest foundation for this particular article of his indictment.

PROP. 5. *His examination of the text of Josephus is alike one-sided, inadequate, and erroneous.*

Easy to say, hard to prove. So long as the authorities whom I have cited are on my side, I do not know why this singularly temperate and convincing dictum should trouble me. I have yet to become acquainted with Mr. Gladstone's claims to speak with an authority equal to that of scholars of the rank of Schürer, whose obviously just and necessary emendations he so unceremoniously pooh-poohs.

PROP. 6. *Finally, he sets aside, on grounds not critical or historical, but purely subjective, the primary historical testimony on the subject, namely, that of the three synoptic Evangelists, who write as contemporaries and deal directly with the subject, neither of which is done by any other authority.*

Really this is too much! The fact is, as anybody can see who will turn to my article of February, 1889 [Popular Science Monthly, April, 1889], out of which all this discussion has arisen, that the arguments upon which I rest the strength of my case touching the swine-miracle, are exactly "historical" and "critical." Expressly, and in words that can not be misunderstood, I refuse to rest on what Mr. Gladstone calls "subjective" evidence. I abstain from denying the possibility of the Gadarene occurrence, and I even go so far as to speak of some physical analogies to possession. In fact, my quondam opponent, Dr. Wace, shrewdly, but quite fairly, made the most of these admissions, and stated that I had removed the only "consideration which would have been a serious obstacle" in the way of his belief in the Gadarene story.*

So far from setting aside the authority of the Synoptics on "subjective" grounds, I have taken a great deal of trouble to

* Nineteenth Century, March, 1889, p. 362 [Popular Science Monthly, May, 1889, p. 76].

show that my non-belief in the story is based upon what appears to me to be evident: firstly, that the accounts of the three synoptic Gospels are not independent, but are founded upon a common source; secondly, that even if the story of the common tradition proceeded from a contemporary, it would still be worthy of very little credit, seeing the manner in which the legends about mediæval miracles have been propounded by contemporaries. And, in illustration of this position, I wrote a special essay about the miracles reported by Eginhard.*

In truth, one need go no further than Mr. Gladstone's sixth proposition to be convinced that contemporary testimony, even of well-known and distinguished persons, may be but a very frail reed for the support of the historian, when theological prepossession blinds the witness.†

PROP. 7. *And he treats the entire question, in the narrowed form in which it arises upon secular testimony, as if it were capable of a solution so clear and summary as to warrant the use of the extremest weapons of controversy against those who presume to differ from him,*

The six heretical propositions which have gone before are enunciated with sufficient clearness to enable me to prove without any difficulty that, whosesoever they are, they are not mine. But number seven, I confess, is too hard for me. I can not undertake to contradict that which I do not understand.

What is the "entire question" which "arises" in a "narrowed form" upon "secular testimony"? After much guessing, I am fain to give up the conundrum. The "question" may be the

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* The Value of Witness to the Miraculous. Nineteenth Century, March, 1889. [Popular Science Monthly, September, 1889.]

† I can not ask the editor of this Review to reprint pages of an old article—but the following passages sufficiently illustrate the extent and the character of the discrepancy between the facts of the case and Mr. Gladstone's account of them:

"Now, in the Gadarene affair, I do not think I am unreasonably skeptical, if I say that the existence of demons who can be transferred from a man to a pig does thus contravene probability. Let me be perfectly candid. I admit I have no *a priori* objection to offer. . . . I declare, as plainly as I can, that I am unable to show cause why these transferable devils should not exist." . . . (Agnosticism, Nineteenth Century, 1889, p. 177.) [Popular Science Monthly, April, 1889, pp. 758, 759.]

"What then do we know about the originator, or originators, of this groundwork—of that threefold tradition which all three witnesses (in Paley's phrase) agree upon—that we should allow their mere statements to outweigh the counter-arguments of humanity, of common sense, of exact science, and to imperil the respect which all would be glad to be able to render to their Master?" (Ibid., p. 175.) [Popular Science Monthly, p. 756.]

I then go on through a couple of pages to discuss the value of the evidence of the Synoptics on critical and historical grounds. Mr. Gladstone cites the essay from which these passages are taken, whence I suppose he has read it; though, it may be, that he shares the impatience of Cardinal Manning where my writings are concerned. Such impatience may account for, though it will not excuse, his sixth proposition.

ownership of the pigs or the ethnological character of the Gadarenes; or the propriety of meddling with other poeple's property without legal warrant. And each of these questions might be so "narrowed" when it arose "on secular testimony" that I should not know where I was. So I am silent on this part of the proposition.

But I do dimly discern in the latter moiety of this mysterious paragraph a reproof of that use of "the extremest weapons of controversy" which is attributed to me. Upon which I have to observe that I guide myself in such matters very much by the maxim of a great statesman, "*Do ut des.*" If Mr. Gladstone objects to the employment of such weapons in defense, he would do well to abstain from them in attack. He should not frame charges which he has, afterward, to admit are erroneous, in language of carefully calculated offensiveness (Impregnable Rock, pp. 269, 270); he should not assume that persons with whom he disagrees are so wrecklessly unconscientious as to evade the trouble of inquiring what has been said or known about a great question (Impregnable Rock, p. 273); he should not qualify the results of careful thought as "hand-over-head reasoning" (Impregnable Rock, p. 274); he should not, as in the extraordinary propositions which I have just analyzed, make assertions respecting his opponent's position and arguments which are contradicted by the plainest facts.

Persons who, like myself, having spent their lives outside the political world, yet take a mild and philosophical concern in what goes on in it, often find it difficult to understand what our neighbors call the psychological moment of this or that party leader; and are, occasionally, loath to believe in the seeming conditions of certain kinds of success. And, when some chieftain, famous in political warfare, adventures into the region of letters or of science, in full confidence that the methods which have brought fame and honor in his own province will answer there, he is apt to forget that he will be judged by these people; on whom rhetorical artifices have long ceased to take effect; and to whom, mere dexterity in putting together cleverly ambiguous phrases, and even the great art of offensive misrepresentation, are unspeakably wearisome. And, if that weariness finds its expression in sarcasm, the offender really has no right to cry out. Assuredly ridicule is no test of truth, but it is the righteous meed of some kinds of error. Nor ought the attempt to confound the expression of a revolted sense of fair dealing with arrogant impatience of contradiction, to restrain those to whom "the extreme weapons of controversy" come handy from using them. The function of police in the intellectual, if not in the civil, economy may sometimes be legitimately discharged by volunteers.

Some time ago, in one of the many criticisms with which I am favored, I met with the remark that, at our time of life, Mr. Gladstone and I might be better occupied than in fighting over the Gadarene pigs. And, if these too famous swine were the only parties to the suit, I, for my part, should fully admit the justice of the rebuke. But, under the beneficent rule of the Court of Chancery, in former times, it was not uncommon that a quarrel about a few perches of worthless land ended in the ruin of ancient families and the ingulfing of great estates; I think that our admonisher failed to observe the analogy—to note the momentous consequences of the judgment which may be awarded in the present apparently insignificant action *in re* the swineherds of Gadara.

The immediate effect of such judgment will be the decision of the question whether the men of the nineteenth century are to adopt the demonology of the men of the first century as divinely revealed truth, or to reject it as degrading falsity. The reverend Principal of King's College has delivered his judgment in perfectly clear and candid terms. Two years since, Dr. Wace said that he believed the story as it stands; and consequently he holds, as a part of divine revelation, that the spiritual world comprises devils, who, under certain circumstances, may enter men and be transferred from them to four-footed beasts. For the distinguished Anglican divine and biblical scholar, that is part and parcel of the teachings respecting the spiritual world which we owe to the founder of Christianity. It is an inseparable part of that Christian orthodoxy which, if a man rejects, he is to be considered and called an "infidel." According to the ordinary rules of interpretation of language, Mr. Gladstone must hold the same view.

If antiquity and universality are valid tests of the truth of any belief, no doubt this is one of the beliefs so certified. There are no known savages, nor people sunk in the ignorance of partial civilization, who do not hold them. The great majority of Christians have held them and still hold them. Moreover, the oldest records we possess of the early conceptions of mankind in Egypt and in Mesopotamia prove that exactly such demonology, as is implied in the Gadaran story, formed the substratum, and, among the early Accadians, apparently the greater part, of their supposed knowledge of the spiritual world. M. Lenormant's profoundly interesting work on Babylonian magic and the magical texts given in the appendix to Prof. Sayce's Hibbert Lectures leave no doubt on this head. They prove that the doctrine of possession, and even the particular case of pig possession,* were firmly believed in

* The wicked, before being annihilated, returned to the world to disturb men; they entered into the body of unclean animals," often that of a pig, as on the sarcophagus of Seti I in the Soane Museum."—LENORMANT, Chaldean Magic, p. 88, editorial note.

by the Egyptians and the Mesopotamians before the tribes of Israel invaded Palestine. And it is evident that these beliefs, from some time after the exile and probably much earlier, completely interpenetrated the Jewish mind and thus became inseparably interwoven with the fabric of the synoptic Gospels.

Therefore, behind the question of the acceptance of the doctrines of the oldest heathen demonology as part of the fundamental beliefs of Christianity, there lies the question of the credibility of the Gospels, and of their claim to act as our instructors, outside that ethical province in which they appeal to the consciousness of all thoughtful men. And still, behind this problem, there lies another—how far do these ancient records give a sure foundation to the prodigious fabric of Christian dogma which has been built upon them by the continuous labors of speculative theologians during eighteen centuries?

I submit that there are few questions before the men of the rising generation on the answer to which the future hangs more fatally than this. We are at the parting of the ways. Whether the twentieth century shall see a recrudescence of the superstitions of mediæval papistry, or whether it shall witness the severance of the living body of the ethical ideal of prophetic Israel from the carcass, foul with savage superstitions and cankered with false philosophy, to which the theologians have bound it, turns upon their final judgment of the Gadarene tale.

The gravity of the problems ultimately involved in the discussion of the legend of Gadara will, I hope, excuse a persistence in returning to the subject, to which I should not have been moved by merely personal considerations.

With respect to the diluvial invective which overflowed thirty-three pages of this Review last January, I doubt not that it has a catastrophic importance in the estimation of its author. I, on the other hand, may be permitted to regard it as a mere spate; noisy and threatening while it lasted, but forgotten almost as soon as it was over. Without my help, it will be judged by every instructed and clear-headed reader; and that is fortunate, because, were aid necessary, I have cogent reasons for withholding it.

In an article characterized by the same qualities of thought and diction, entitled A Great Lesson which appeared in this Review for September, 1887, the Duke of Argyll, firstly, charged the whole body of men of science interested in the question with having conspired to ignore certain criticisms of Mr. Darwin's theory of the origin of coral reefs; and, secondly, he asserted that some person unnamed had "actually induced" Mr. John

Murray to delay the publication of his views on that subject "for two years."

It was easy for me and for others to prove that the first statement was not only, to use the Duke of Argyll's favorite expression, "contrary to fact," but that it was without any foundation whatever. The second statement rested on the Duke of Argyll's personal authority. All I could do was to demand the production of the evidence for it. Up to the present time, so far as I know, that evidence has not made its appearance; nor has there been any withdrawal of, or apology for, the erroneous charge.

Under these circumstances, most people will understand why the Duke of Argyll may feel quite secure of having the battle all to himself, whenever it pleases him to attack me.—*Nineteenth Century.*

HEAD-FLATTENING AS SEEN AMONG THE NAVAJO INDIANS.

By Dr. R. W. SHUFELDT.

A LITTLE over a year ago, when in the northwestern part of New Mexico, the opportunity was afforded the writer to make a great many observations upon the Navajo Indians, the tribe found in that section of the country. Those studies, which took into consideration in several instances their simple arts and industries, have been published in various quarters; but a widely different field of research, for which they also afforded the material, especially interested me at the time, and this was the subject of their craniology.

On a number of occasions fine specimens of the skulls of those Indians, of both sexes and all ages, fell into my hands; while the peculiar distortion several of these presented at once commanded my attention. In the main this distortion consisted in either a direct or an oblique posterior flattening of the skull; and that it was a characteristic to be seen in many of the heads of the representatives of that tribe of North American Indians has long been a well-ascertained fact.

For an equal length of time has the cause of this flattening of the skull among the Navajos generally been attributed to a pressure brought to bear over the region in question during the infancy of the individual exhibiting it. This was also my own preconceived opinion, an opinion which had become more or less fixed by all my previous reading upon the subject, but not through personal examination of the proper material itself, under the most favorable circumstances possible.

Among the first if not the first specimen that came into my possession was the skull of an adult male Navajo, and, after a careful study of it, it was presented to the craniological section of the Anatomical Museum of the University of Edinburgh, where it now is. This was early in 1886; and in the April number of that year of the Journal of Anatomy and Physiology of London, the writer published his observations upon that skull, the paper being illustrated by a fine lithographic plate presenting the four principal views of the same.

In the same number of the Journal which I have named above, Prof. Sir William Turner contributed an additional note upon the same skull, wherein he says that it "presented a well-marked parieto-occipital flattening, obviously due to artificial pressure, which had been applied so as to cause the suprasquamous part of the occipital bone and the posterior three fourths of the parietal to slope upward and forward."

"The frontal region did not exhibit any flattening, so that in this individual, and it may be in his tribe of Indians, the pressure applied in infancy was apparently limited to the back of the head. Owing to this artificial distortion, the longitudinal diameter of the head was diminished, and the cephalic index, 94·6, computed from Dr. Shufeldt's measurements of the length and breadth, was therefore higher than it would have been in an undeformed skull. The cranium was hyperbrachycephalic."

This, and much more, was set forth in Dr. Turner's valuable "note" upon my specimen; but it was hard for me to see how a baby could have pressure applied to the back of its skull of sufficient amount to produce the flattening found, unless there was a *counter-pressure* applied at the *opposite* aspect of the skull, which naturally would produce there perhaps a similar flattening or some other distortion, and this latter deformity is never seen to exist in the skulls of the Navajos. As I say, at the time I read Dr. Turner's note, I was in a position to examine this question quite thoroughly, as these Indians were living all about me, and I saw the Navajo women daily with their infants strapped in their cradles.

It will be seen in the sequel that my subsequent observations in the premises compelled me to hold a different opinion from the one advanced above by so eminent an authority as is Sir William Turner.

Another skull which soon fell into my hands was a fine specimen from a young Navajo girl of some six or seven years of age, and it showed this peculiar flattening to a very marked degree. By the aid of my camera I am enabled to present herewith two figures of the skull of this individual, showing the flattening from two views.

Upon every occasion where I was permitted to do so, careful examinations were made of the heads of these people, both living and dead, as well as the methods of strapping the infant Navajos in their cradles, and indeed all else that might tend to throw light upon the subject.

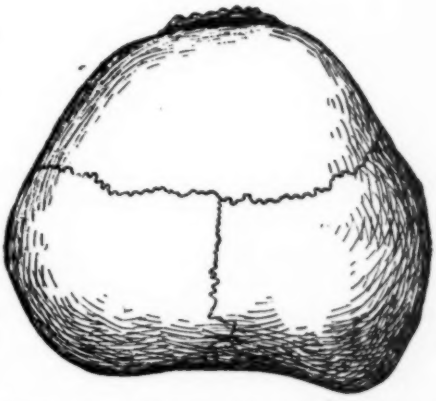

FIG. 1.—DIRECT SUPERIOR VIEW OF THE SKULL OF A NAVAJO INDIAN CHILD OF ABOUT SIX AND A HALF YEARS OF AGE, AND PROBABLY A FEMALE. (Considerably reduced.)

Of some two or three dozen children of all ages, from the infant upward, that I have thus examined, I have yet to find a case wherein the mother has not taken the special precaution to place a soft and ample pad in the cradle in such a manner as to fully protect the back of the child's head. Moreover, I have yet to see a case, except for a few days or more in the very youngest of babies, where the head is strapped at all. On the other hand, this part of the body is allowed all possible freedom, as may be seen in Fig. 3, illustrating the paper. This picture is from a photograph of the Navajo woman "Chuna," who lives near Fort Wingate, New Mexico, and it shows exactly the general method employed by the mothers of this tribe of Indians in strapping their babies in the cradle, and also their mode of carrying the cradle.* It will at once be observed that the head of the child is perfectly free, and that it has been supplied by a thick and soft pillow at the back of it, whereas the body and limbs have been strapped up almost to the last degree.

FIG. 2.—RIGHT LATERAL ASPECT OF THE SAME SKULL SHOWN IN FIG. 1.

* The cradle shown in this illustration is now in the collections of the United States National Museum, at Washington, where it was deposited by the writer.

This child, being a "half-breed," has light, thin hair, through which the general form of its skull could be easily examined; but,

FIG. 3.—NAVAJO WOMAN CARRYING HER BABY.

after the most careful measurements, I failed to detect any flattening whatever of the occipital region of the head. In examining

the full-blooded infants of different ages of this tribe, I occasionally found one wherein I thought I could satisfactorily determine that the back of its head was unduly flattened, but it was by no means always the case.

Another thing must be remembered, and that is that these Navajo women do not always keep their infants thus strapped up in their cradles, and this fact goes to sustain that whatever pressure is brought to bear against the backs of their heads is *not a constant* one. We often see little Navajo babies playing about for hours together, and that at a time when they are scarcely able to walk.

Among the older children, as well as I could do so through their thick mats of hair, I have on one or more occasions satisfied myself that the hinder region of their heads was flattened, though it was but rarely the case that one was met with that exhibited this to a degree found in the skull figured in the present paper.

Such examinations as I have been enabled to make thus far very thoroughly convince me that this head-flattening is *not* due to the mode of strapping that part of the body employed by the Navajo mothers of the present day. In ages or generations gone by the ancestors of those Indians may have resorted to a very different method of fastening the infant's head in its cradle: perhaps it may have been more firmly fixed by thongs, and a pressure brought to bear upon the occiput, and that of a nature to produce the distortion in question; but so far as the writer is aware we have no such record for this tribe. How much heredity may have to do with it, then, we are not fully prepared to answer. And in any event we must bear in mind, when considering this matter, that the distortion, if it may be so termed, does not occur by any means in the skulls of all the representatives of the Navajos; nor is it limited to either sex; nor does it disappear as age advances; nor does the plane of the flattened surface of the occiput always bear the same relation to other planes of the skull, as the flattening may be central, or it may be more or less lateral, and so on; and, finally, it varies greatly in degree.

That skull-distortion, due to various modes of artificial pressure, is to be seen among divers peoples still in existence, as well as in the preserved skulls of former races that inhabited the earth, there can be no question; and it would seem, in the light of what we have attempted to bring out in this paper, that one of the most interesting points to decide with respect to it is whether such a feature can become hereditary.

At all events, the subject is full of interest, and will bear, it appears to me, further and fuller investigation.

THE RELATIONS OF ABSTRACT RESEARCH TO PRACTICAL INVENTION.*

By F. W. CLARKE.

A HUNDRED years ago, just after the first American patent was issued, two other events, fitly to be mentioned here, became a part of history. In 1791 Galvani published his famous book on animal electricity; and at about the same time the Royal Society gave its highest honor, the award of the Copley Medal, to Volta. Between these events and the passage of our first patent law no connection was then apparent, nor for many years afterward did any relation become obvious. The patent system dealt with affairs of practical utility, while Galvani and Volta were mere visionaries, prying into matters of only speculative interest, and of no real value or importance to anybody. Indeed, Galvani was ridiculed throughout Europe as "the frogs' dancing-master," so remote from all material considerations, so useless to all outward seeming, were his investigations.

In spite of ridicule and indifference, however, the unpractical researches went on, from step to step, from discovery to discovery, until at last they ripened into invention. Galvani and Volta had worthy successors—Oersted, Ampère, Ohm, Faraday, Henry, and others—all devoted to knowledge for its own sake, and caring little for any reward other than the consciousness of achievement. The voltaic pile, the galvanic battery, and the electro-magnet were added to the resources of science; facts, principles, and laws came into recognition; and suddenly a relation of the work done to the work the great world was doing became manifest. Nearly half a century was passed in these preliminaries, and then came the inventions of electro-metallurgy, of the telegraph, and of all the hurrying swarm of wonders that mark this "age of electricity." Suddenly the Patent Office became a center of interest in what at the date of its foundation had been apparently remote from its purposes; and to-day, grown from the germs of a century ago, we see one of the chief objects of its activity. All now know the merit of Galvani's work, and yet its lesson of history is far too seldom realized. Every true investigator in the domain of pure science is met with monotonously recurrent questions as to the practical purport of his studies; and rarely can he find an answer expressible in terms of commerce. If utility is not immediately in sight, he is pitied as a dreamer, or blamed as a spendthrift of time; for the questioning man of affairs can recognize only affairs, and to him speculations not convertible into coin of

* An address delivered at the Patent Centennial in Washington, April 9, 1891.

the realm must naturally seem profitless. High aims count for little or nothing—results, and tangible results at that, are wanted.

It would be easy to multiply instances in illustration of my meaning. For example, iodine, discovered in 1812 by Courtois, was for many years a chemical curiosity. Why should any one waste his time in the study of so useless a body? To-day industries unknown to Courtois, born since his day, find in iodine one of their most necessary appliances. Photography, one of the arts in which iodine is useful, itself grew out of researches which were seemingly useless when made; and the camera, its most essential implement, was once only a philosopher's plaything. Investigations which had only the pursuit of truth for its own sake as a justification, brought rainbows of color out of coal; and coal-tar, not forty years ago a nuisance to be thrown away, is now a source of profit and prodigal of beauty. From the same hopeless material, through researches still unaimed at profit, have come the latest and best additions to our *materia medica;* and so again the methods of Science, as applied by her highest votaries, are vindicated by the fruits they bear. In short, every department of invention, every advance in civilization, owes much to the student; no industry is independent of the results won by purely abstract research. Even the most trivial details of modern life are affected by the work of the scientific investigator; luxuries and necessaries alike are influenced; and so obtrusively evident is this truth to most of us, that, taking it for granted, we daily ask, "What next?" Indeed, our gratitude to Science is often manifested in that cynical form which has been wittily defined as "a lively sense of favors yet to be received." We expect more in the future than we have realized in the past, and, as the marvels of the last century become commonplace, we look for new wonders which shall be even greater. The magic of the ancients is already outdone, and still the tide of discovery has not reached its flood. To preserve what we have gained, and to insure the promise of the years to come, is the problem before us. Speaking in the interest of future invention we may fairly ask, How best shall the work of investigation be furthered?

It is an old saying, and one partly true, that what has been, shall be. We may, therefore, consider through what agencies science has heretofore grown, and so recognize the foundations upon which building is possible. These agencies, briefly summarized, are as follows: First, individual enterprise; second, schools and universities; third, learned societies and endowments; fourth, government aid. Like nearly all classifications this list is imperfect, for it represents only one phase of the truth; and the several items, far from being distinct, shade into one another through many gradations of circumstance. Among them all, in-

dividual enterprise comes properly first, for, without that, without the influence of guiding spirits, the other agencies must fail. In a restricted sense, however, except perhaps as regards the beginnings of science, individual enterprise is the weakest force of all. To the modern investigator leisure and opportunities are necessary; in chemistry and physics, at least, apparatus and laboratories are indispensable; and few men working alone can command either the needful time or the bare material resources. During this century nine tenths of the great discoveries have been made by men with institutions back of them, through the aid of which the work was rendered possible. Wealth, scholarship, ability, and the spirit of research too seldom go together; and happy is the man in whom all these conditions are fortunately united. Under our second heading, in the shelter of schools and universities, the science of to-day has chiefly been developed.

The truth of my last statement may be verified by a reference to the files of those standard scientific journals in which original researches are recorded, or by scrutinizing in detail the history of any great discovery. In either case, whether we consider this country or Europe, the university work will be found to predominate overwhelmingly, and for obvious reasons. Every true university is something more than a distributor of knowledge; it is a producer of knowledge also; and in Germany, where the university system is most fully developed, the two functions are equally recognized. A German student, aspiring to academic honors, must do original work, and the professors' chairs are always filled from among the men who have most distinguished themselves as investigators. A chemist who had done nothing for pure science could hardly be recognized in Germany; not one of the higher professional positions would be within his reach; erudition alone, unsustained by evidence of creative ability, would do little for his advancement. In consequence of this policy, Germany now leads the scientific world; and, in consequence of that leadership, a certain industrial supremacy is fast becoming hers. One example will serve to illustrate the tendency to which I refer. The aniline dyes were discovered by Perkin in England about thirty-five years ago, and in that country the manufacture began. To-day, through the researches of German universities, Germany is the center of the coal-tar industry, and Engalnd has only a subordinate rank. Until recently the English universities have slighted experimental science, and English manufactures are paying for the neglect. One German firm alone, producers of coal-tar colors, employs over fourteen hundred workmen; but with them there are about fifty scientific chemists, every one a man trained in pure research, the product of the university system. These men are engaged to make investigations; to improve

processes; to discover new compounds of value; and, in short, to use the most vigorous methods of science for the up-building of industry. The German manufacturer does not employ a chemist who has only learned by rote the wisdom gained by others; he does not ask to be told that which he already knows; he seeks rather to push forward into new fields; to excel his competitors more by intelligence than by brute force; and to gain a growing supremacy in preference to a mere victory for the moment. This practical policy, the outgrowth of intellectual culture, has made Germany a dangerous rival to all other countries in those departments of industry which rest upon scientific foundations. Applied science can not exist until there is the science to apply; and, where the latter is most favored, the industrial development is sure to be most perfect. This lesson is one which the United States must learn more thoroughly than heretofore, if it hopes to hold its own in the front rank of manufacturing nations. In a few of our universities the truth is already realized; but in too many American schools the so-called "practical" view prevails. Under the latter, teaching becomes routine; and the student, while learning elaborately that which is known, is not taught how to discover. He has little or no training in the art of solving unsolved problems; and that art is the mainspring of modern industrial growth. A teacher of science ought also to be an investigator, were it only for the inspiration that his example might give to the pupils in his charge. To impart knowledge is a good thing, but to reveal the sources of knowledge is better; and in that revelation is found the educational value of research regarded as a part of the teacher's essential duty.

The third agency for the advancement of investigation, the organization of scientific societies, shades imperceptibly into the other three. Private workers and university teachers here come together for purposes of co-operation, and in many countries the associations formed are aided by the state. As a rule, the great European academies are directly or indirectly patronized by the Government, and occasionally endowments are bequeathed to them by private individuals for the foundation of prizes or medals, or for the assistance of research. In our own country the societies and academies are sustained by private enterprise, but some of them hold endowments of considerable value. Partly through the latter, partly through the stimulus to effort given by awards of honor, and more largely as publishers of results, they do their greatest good, and render to science services of unmistakable value. A large proportion of the leading scientific journals are published by organized societies, and without these discovery would oftentimes be dumb.

Of government aid, the fourth great means for furthering re-

search, little need here be said. Ostensibly such aid is given for selfish motives, since every modern government demands the help of science in return. Nowadays no government could long exist were it deprived of all the resources for defense and intercommunication which science has invented. The relation between science and the state, therefore, is a mutual relation, and each needs the assistance of the other. In Washington the fact is manifest; it is recognized in the organization of nearly every administrative department; and nowhere is it more apparent than under the Commissioner of Patents. From science the Government is daily receiving benefits; to science, therefore, it is rightly a liberal giver; and through its patronage many investigations become possible which, because of their magnitude, would be beyond the reach of private undertaking. Doubtless the time will come when the scientific resources of the national capital will be concentrated more than they are now, and so made more efficient; and sooner or later they should be crowned by the establishment of a national university, in which the highest and most productive scholarship may find a fitting home.

So far my statements have been tinged with rose-color. The great achievements of science command our admiration, and admirable also are the agencies by which it has been advanced. Still, much remains to be done, and many are the gaps in our knowledge. Take any important series of physical data, or any well-defined group of chemical compounds, bring the facts together in systematic form, and the strangest deficiencies will become manifest. Take, for example, those physical properties of the chemical elements which are capable of quantitative measurement, and not for one of them are the attainable data even approximately complete. Even iron, copper, gold, silver, and mercury are but imperfectly known. Were it not for theory, that apprehension of natural law through which science can prophesy, reaching out from the seen to the unseen, a great part of our knowledge would be little more than bare empiricism, and research itself would lack its keenest implement. It is common among ignorant men, themselves wildly speculative, to affect a contempt for theory, and yet without theory science could not exist. All great discoveries begin with theory, and lead up to wider generalizations upon which new researches find a secure foothold. The history of science teaches no more certain lesson than this.

It is easy to find a reason for the incompleteness of our knowledge. Apart from the vastness of the field to be explored, itself a sufficient excuse for ignorance, the more obvious deficiencies are due to excessive individualism in research. Thousands of earnest men are working independently, with insufficient reference to one

another, each attacking that corner of the unknown which most attracts his fancy. All are ambitious to accomplish great results, each one hopes to make some discovery of signal importance; and so the drier and less attractive details of investigation are oftentimes neglected. The field is cut up into many fields, between which the ground is uncultivated, and there no harvest is gathered. To systematize research, to bring about co-operation, to put the art of discovery itself more truly upon a scientific basis, is a problem for the future. In the final solution of this problem the practical inventor may help. The wealth created by invention should serve as the organizer. The law of mechanics that action and reaction are equal and opposite, applies to human affairs as well as to physical forces. Hence, since scientific discovery makes invention possible, it is clear that the inventor owes something to science in return. That some of the harvest should go back to its source as seed is not an unreasonable expectation. Indeed, it is justified by history; and if we trace back to their origin the endowments of our universities, we shall find that the successful inventors have done their fair share. What more is needed, and on what new lines?

In the science of astronomy this question is partly answered already. Every endowed observatory is an institution for research, and outside of that the observers have little else to do. They are employed primarily to gather and discuss data, the raw material of science, and all other duties are secondary. In the solution of large problems several observatories may co-operate, each taking a definite and prescribed portion of the field; and so the science grows symmetrically, with fewer gaps than exist in other departments of knowledge. Perfection of work, completeness in the absolute sense of the term, is of course unattainable, but to that ideal within the limits of its province astronomy approaches most nearly. By its example the other sciences may profit.

Now, for chemistry and physics institutions should be organized resembling in policy the astronomical observatories. I mean, of course, endowed laboratories for research, in which the greater problems could be effectively handled, and important data determined with the highest accuracy. The more precise and at the same time the most difficultly measurable physical constants are of direct value to industrial science, and their determination should not be left to the caprice or convenience of individuals. They represent routine work of the most tedious kind; their measurement involves the highest degree of skill and the most elaborate resources, and they are the foundation-stones of exact theory. They are needed by pure and applied science alike; and yet, under existing conditions, their determination is but scantily

encouraged. They yield to the investigator results more solid than brilliant; they do not give quick returns of fame; and so other researches, more showy or more profitable, are in greater favor. With most men of science, unfortunately, research is a matter secondary to other duties; the professor must teach, the commercial chemist must analyze; and only the time left over, the occasional leisure hour, is available for higher studies. Many an able man, willing and enthusiastic, who might otherwise benefit mankind by investigation, is crowded out of the field by sheer necessity. He is loaded with labors which leave no time for research, and his capacities are exhausted in mere routine. For such men opportunities should not be altogether wanting.

Sometimes the kind of work here indicated has been carried on at public expense; for example, the classical researches of Regnault upon gases and vapors were maintained by the French Government; but all such assistance has been sporadic, while the investigations needed should be continuous and systematic. In a laboratory endowed, equipped, and manned for research only, a rich harvest of results would be sure, far exceeding in value the cost of the undertaking. No such laboratory, I believe, now exists in the civilized world; and the United States might well have the glory of being the first organizer. In its Patent Office it has led all other nations, and in the science which underlies invention it might lead also. To the manufacturers and inventors of America I offer these suggestions, in the hope that they may be speedily realized.

GINSENG IN COMMERCE.

By J. JONES BELL, M. A.

IT is curious that, after the lapse of over a century and a half, the old Canadian industry of gathering, drying, and exporting ginseng should be revived. This root was one of the first articles exported from Canada after the Treaty of Utrecht, and for a time was considered hardly less important in commerce than fur. The revival of the industry is due to the demand for ginseng among Chinese, who have become a no inconsiderable element in the the population of the United States, whither the most, if not all, of what is now exported finds its way.

The ginseng of commerce is the fleshy root of a perennial herb, formerly called *Panax quinquefolium*, but now placed among the dicotyledonous *Araliaceæ*. The Chinese ginseng is probably derived from another species of the same genus. It is a native of the Middle and Northern States and Canada, but is found far south on the mountains. It grows in rich soil, in shaded situa-

tions, and has a fleshy root from four to nine inches long, which throws up a simple stem about a foot high, bearing at the top three long-petioled leaves, each of which has five divisions. The stem terminates in a small umbel of inconspicuous greenish-white flowers, which are succeeded by a small, berry-like red fruit. It has a peculiar and rather pleasant smell, and a sweet, somewhat pungent, aromatic taste. According to the Chinese, the root nourishes and strengthens the body, checks vomiting, removes hypochondriasis and other nervous affections, gives a vigorous tone to the system, even in old age, and is, in short, a panacea for all the ills to which flesh is heir. European and American doctors consider it almost worthless as a remedy, though it is sometimes used as a domestic medicine in the States west of the Alleghanies. *Panax fruticosus* and *Panax cochleatus*, plants somewhat akin to ginseng, are fragrant aromatics, which grow in the Moluccas, and are used by the native practitioners of India. With such unbounded faith in its beneficial effect both on body and mind, what wonder that the discovery that stores of ginseng are yet to be found in Canada should have created a demand among the Celestial population on this continent, and that the industry of digging and preparing it for market should have assumed very considerable proportions!

GINSENG (*Aralia quinquefolia*).

As already stated, the trade in ginseng is a revival of one that formerly existed. In the autumn of 1716 Père Joseph François Lafitan, a Jesuit father, who had arrived in the country in 1712, and was stationed at the Sault, above Montreal, discovered the plant. He had been in Quebec in 1715, and there saw a letter of Père Jartoux, who had seen ginseng in Tartary in 1709, and who gave a description of it. Lafitan inquired about it from the Indians, and examined the country to find it. At this time it was worth its weight in gold at Pekin. A company was formed to export it to China, Japan, and Tartary. The price at Quebec was from thirty to forty sous or cents per pound. At first any one was allowed to sell it, but as its value increased the company exercised its monopoly rights, and in 1751 undertook to exclude all others from the trade. As the demand increased, the care with which it was obtained and prepared was relaxed. It was gathered

out of season, and imperfectly dried in stove-ovens. Even in this state it brought twenty-five livres per pound. In 1752 ginseng of this character to the value of five hundred thousand livres was exported. In 1754 the value of the export had fallen to thirty-three thousand livres. A quantity sent to La Rochelle remained unsold, but finally found its way to China, where its inferior quality gave the Canadian article a bad reputation; the demand fell off, and the export ceased. When the trade was at its height it was considered more profitable to gather ginseng than to cultivate the farm, and agriculture was almost entirely neglected. The result was, that the plant almost entirely disappeared. It came to be a proverb among the people, when speaking of some matter that had failed, "C'est tombé comme le ginseng." *

The revival of the trade has caused great activity in the search for the plant throughout the country back of Kingston, where it is said to abound. The profits on it are stated to be four hundred per cent, and one druggist there cleared three thousand dollars in one deal. The average wholesale price is one dollar per pound, the retail price five dollars. If the trade is to be preserved, care will have to be taken to prepare the root properly and not dig it up indiscriminately, as the root does not reach any great size in one season, but takes years to develop. In the desire to participate in the profits of the trade, some curious mistakes have been made. One man, who thought he had a rich find in Manitoba, discovered, after buying several tons, that he had not the right article. Many have confused gentian with ginseng, and, on testing the root of the former, have wondered why the Chinese were so fond of the latter.

The Chinese word *gen-seng*, and the Iroquois word *garent-oquen*, the Indian name of the plant, both mean "a man's thigh," and have doubtless been applied because of a supposed resemblance of the root to that part of the human body. This coincidence Père Lafitan could not consider fortuitous, and upon it he based an argument that America had once been joined to Asia, and that the Indian population of the former had originally come from the latter before the continents were severed at Bering Strait. The accompanying figure gives a general idea of the appearance of the plant.

EXPERIMENTS were made last year by Signor Tacchini, at Rome, on the influence of passing wagons, etc., on the seismological instruments in the tower of the college, forty metres above the level of the city. The oscillations produced by the marching of a regiment of soldiers, 150 metres away, were registered by the apparatus. The result both shows the sensitiveness of the instruments and illustrates the necessity of placing geodynamic observatories as far as possible from any disturbing agencies.

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* It has gone down like ginseng.

SKETCH OF FRIEDRICH W. A. ARGELANDER.

ARGELANDER, says Prof. E. Schoenfeld, was pre-eminently an astronomical observer. In his youth he could handle every instrument as he could his pen. With his great keenness of vision, this occupation was attractive to him; but he realized that it was a means to an end. He found his life-work in collecting materials for a theory of the universe. Most of his work in Bonn was devoted to acquiring the completeness attainable under the limited capacity of the instruments in use in the knowledge of the fixed stars. To him we owe the demonstration of the proper motion of the solar system through space, and one of the fullest and most accurate of the older charts and catalogues—a work which remains a standard for reference. The materials for our sketch are derived wholly from the biography published shortly after his death by Prof. Schoenfeld, his successor at Bonn, in the Vierteljahrsschrift der astronomischen Gesellschaft.

FRIEDRICH WILHELM AUGUST ARGELANDER was born on the 22d of March, 1799, at Memel, in East Prussia, and died at Bonn, February 17, 1875. He was the son of the merchant Johann Gottfried Argelander, of descent on the father's side from Finland, while his mother was German. The relations of the family with the outer world favored the most careful training of the future astronomer. The political conditions existing during his childhood brought him early into closer relations with the great world than could have been expected to arise in the ordinary course of events in the little village so remote from the capital. The Prussian royal family had left Berlin after the unfortunate issue of the campaign of 1806, and ultimately retired to Memel. The crown prince, afterward King Friedrich Wilhelm IV, and Prince Friedrich lived in the house of Argelander's parents; and, notwithstanding the difference of three years and a half in their ages, a warm and lasting friendship was formed between the former and Argelander. Hardly less cordial was the relation of Prince Wilhelm, the late Emperor of Germany. But the times were in all other respects times of trial; and because of this the inner life was all the more richly developed. Argelander afterward attended the Gymnasium of Elbring, and, in 1813, the *Collegium Fridericianum* at Königsberg. When, in 1817, he entered the university he enrolled himself as a student in financial science, and devoted himself earnestly to it; but he soon found himself more attracted to Bessel's astronomical lectures than to all the others.

Having made sufficient advance to undertake work of that kind, he asked Bessel to intrust him with some of the calcula-

tions for the observatory. Bessel, who had then completed his Fundamenti Astronomiæ, gave him some calculations of stars not observed since Bradley that he had identified, and the problem of determining the latitude of the observatory from observation of the pole star not yet worked out. The publication of the results of these labors in the Königsberg observations introduced the author to the scientific world as Bessel's most capable pupil. Other similar calculations followed, and Argelander showed a growing devotion to practical astronomy.

The observation of an occultation of the Pleiades in August, 1820, was regarded by Argelander as his first astronomical observation; and he held a vivid recollection of its incidents in his later years. In October following he was appointed, on Bessel's nomination, assistant at the observatory. Bessel had conceived his plan for a *Durchmusterung*, or sounding of the sky, and had begun upon it, and wanted another astronomer. He employed Argelander to assist him in reading and writing down the micrometric indications on the circle. While waiting for this work to begin, Argelander made observations on setting stars, which were used by Bessel in completing his refraction tables to zenith distances 85° and 89½°, and in observing the comet of 1821. His first independently published paper, written in 1821, as a thesis for the degree of Ph. D., was on Flamstead's Astronomical Observations, and largely concerned the errors of his instruments. A memoir on the comet of 1811 was published shortly afterward. It recorded fuller observations, and covering more time, than had been made before of any comet. Relying upon Bessel's methods for the comets of 1807 and 1815, and realizing that the value of labors of the kind lay in treating the observations exhaustively, he went back to the very beginning of them. Some unexpected difficulties met in the calculations, involving among other things apparent disagreements with the law of gravitation, led him to suppose that some abnormal force worked upon the comet—a hypothesis that was not without influence on Bessel's views concerning the repulsive force of comets' tails. Although Bessel further developed these views in his work on Halley's comet, and in the controversy with Encke, respecting the resisting medium, Argelander was afterward inclined to modify his own opinions, and to hold the question open whether the movements of comets pointed to the operation of foreign forces upon them. On the faith of this paper Argelander was given a license to teach in the university.

The place of Observer at the Observatory of Åbo, Finland, having been made vacant by the death of Walbeck, Bessel was applied to to name a successor. He recommended Argelander, who was appointed in April, 1823. Argelander's journey to Fin-

land was also his wedding tour; and he went by way of Dorpat, where he renewed his friendship with Struve, and St. Petersburg. The observatory at Åbo, newly built, was not yet fully furnished, and the nature of the observations was considerably determined by the consideration of the instruments that were available. The earlier ones were upon comets, and those made with the meridian circle; and Argelander computed the orbit of the comet of 1718 from Kirch's observations.

Attention was next given to the proper motions of the stars, the study of which, although touched upon by Bradley and resumed by Piazzi, was still in its beginning. At this time the Königsberg Observatory was extending the knowledge of the stars in mass; Dorpat, that of double stars; and Greenwich, that of stars visible to the naked eye; and Argelander devoted his observatory to the stars the yearly motion of which was given by Bradley and Piazzi as 0·2″ or more, as well as of those of which were suspected of having motions. These stars were to be observed at least four times a year, in every position of the circle.

The observations made at Åbo were published down to 1828, in three volumes, while the rest were still awaiting publication at the time of Argelander's death. The steps taken to insure the highest accuracy are fully set forth in the introduction to the second volume. The catalogue at once took a first place among the records which gave the fundamental determinations of the star places for 1830. It is also a model for convenience.

The buildings, collections, and library of the university having been destroyed by the great fire which visited Åbo in September, 1827, although the observatory was saved, it was determined to remove the whole concern to Helsingfors. Argelander was appointed a Professor in Ordinary of Astronomy in the new university, but did not remove from Åbo till 1831. Then, having visited his old home after eight years of absence and renewed his association with Bessel, he settled in Helsingfors in August, 1832, while the buildings were still in a backward condition, so that he was not able to make an observation for nearly a year, and all was not complete till September, 1835. To the Helsingfors period belong observations of the brighter circumpolar stars, of the bending of the meridian circle, and the printing of the Åbo catalogue; and the celebrated treatise on the proper motion of the solar system. Supported by the results obtained at Åbo, he found that the regularity of the stellar motions, which is explained by a movement of the sun toward the constellation Hercules, first tentatively announced by Herschel, was borne out by the observations.

In August, 1836, Argelander was invited to remove to the still young University of Bonn, where the Prussian Government had

determined to erect a great astronomical institution. He found most of the labor of fitting up the observatory yet to be done. He was given, as temporary quarters, with poor provisions for his work, a bastion on the Rhine called the Old Zoll.

With irrepressible industry he composed his beautiful work, the New Uranometry, or charts of the stars visible to the naked eye in central Europe, with their true magnitudes taken immediately from the sky. Taking up the field, hitherto but little worked, of the variable stars, he adopted the methods of Herschel, improving the notation. He expressed all the differences in light by numbers, and thereby opened the possibility of investigating phenomena which no one before him had subjected to calculation. Beginning in December, 1838, with observations of Mira Ceti, he included Algol in February, 1840, β Lyræ and other stars in the summer of the same year, and, with these, telescopic stars. At the same time he tried to excite interest in the subject in other quarters, at first with limited, afterward with increasing success; and in a short time this branch of our knowledge of the fixed stars assumed a new form. The discovery in 1843 of the decrease in Algol's period led to more thorough researches on the changes of the periods and their laws. Closer examinations of the older observations were brought in, and much that had been almost lost was looked up and collected. The observations were continued for many years, and it was not till 1859 that Argelander, without giving up his interest in the work, ceased to prosecute it actively, when his eyes were becoming weak, and when the general participation of others in it had satisfied him that it would be carried on.

The New Uranometry had originated, not only in the desire to present an enumeration of the stars, to clear the charts of errors of position and designation, and to furnish observers with the naked eye with a good atlas for orientation, but also out of the conviction of the importance of leaving to posterity a good representation of the relative magnitudes of the brighter fixed stars, in order to make the real secular variations in brightness distinguishable from fancied ones. The dissertation, *De fide Uranometriæ Bayeri*, is a contribution in this direction, and has the great merit of setting out in the right light the true principles from which Bayer had allowed himself to be led in the construction of his charts. Argelander's methods of observation in this field are summarized in an essay in Schumacher's *Jahrbuch* for 1844, from which many who have interested themselves in this line have drawn their instructions. The same work contains the first general summary of our knowledge of the subject from Argelander's hand, an important revision of which is found in Humboldt's Cosmos. This treatise also bespeaks many other phe-

nomena, of which the northern lights only is mentioned, in which Argelander had a great interest. He had made many observations on it in Finland, which he afterward published.

These accounts of special works of Argelander have caused us to anticipate much of the course of events. We return to the beginning of his life in Bonn. While still in the temporary building, having with great care obviated some of the defects of the structure, he proceeded to continue Bessel's zones to the north, from 45° to 80° declination. Thus originated the northern zones, containing 26,424 observations of nearly 22,000 stars. They were begun May 27, 1841, and were concluded as to their most important features in June, 1843, although a few gaps remained to be filled in March and April, 1844. Argelander was so busy in trying to bring them to a close that, although much interested in such bodies, he did not find time to observe the great comet of 1843 in the earlier days of its appearance.

After the completion of the new observatory in 1845, while still keeping on with the meridian observations, Argelander's attention was directed by the discoveries of new planets and comets, that were numerous in the years following, to lesser fields. The lack of exact definitions of star places south of the limits of Bessel's zones led him to the examination of the southern zones, of which he took, between May, 1849, and May, 1852, in 200 zones, 23,250 observations of more than 17,000 stars. The accuracy of these observations is somewhat unequal, but is yet sufficient for the most southern zones, and is for the brighter stars hardly less than that of Bessel's observations. The connection of the two great labors of the *Durchmusterung* was steadily kept in view. But, before the southern zones were done, Argelander had formed the plan of a still larger work. Bessel had already, when he unfolded the plan of the star charts to the Berlin Academy, contemplated the complete place-determination of all the stars to the ninth magnitude; but this had not been accomplished, even after the lapse of a quarter of a century. Argelander had tentatively finished one sheet at great expense, and begun another which he then left to others. When, on the completion of the southern observations, the materials for the charts had come into his hands again and more force was at the disposition of the observatory for other work, Argelander thought the time had come for executing Bessel's old plan. Two men were engaged at once—the astronomer at the telescope and a secretary in an adjoining lighted room to note down the time; and, to economize the time for a work of such magnitude, two pairs of observers alternated with one another. Argelander himself published a description of the methods of observation and reduction employed in the Bonn *Durchmusterung*, which resulted in the great sky-atlas and catalogue of 324,198 stars

between the north pole and two degrees of south declination. Leaving the execution of these observations to his assistants, Argelander started with Struve, in June, 1852, by way of Göttingen and Berlin, to Sweden and Finland, and thence to Pultova, where he spent four weeks, to return at the end of September with the best impressions and in full vigor. The winter and spring of 1854 were so favorable to observations, while the reduction-tables were not far behind them, that Argelander could rejoice in the thought that the atlas would contain from fifty to a hundred thousand more stars than he had originally contemplated. Ever careful to preserve the unity of the whole, he arranged most of the materials himself, and was not willing to let a zone pass without personally working upon it. Double stars and stars with greater proper motions were noted; Winnecke's and Kruger's determinations of parallax were connected with these, and the restoration of lost stars from the older observations afforded ever-new interest. The revisions went on till the summer of 1861; but in some of the regions they no longer required all of Argelander's time, and he was able to pursue other objects. He identified all the stars of the eighth magnitude and brighter, which were not found in the earlier catalogues, with the accessible variable stars, the stars for comparison with the Mannheim observations of nebulæ and for former appearances of periodical comets, and especially many stars with presumed or determined proper motions. Next, while still occupied with the collation of his material, Argelander turned his eye to a work he had long contemplated, of more exact meridian observations of all the stars to the ninth magnitude, of which the *Durchmusterung* had made known the general positions. The labor, too much for a single establishment, was to be divided among different observatories. So, in the summer of 1865, he made a proposition for the simultaneous observation of selected stars at different points, by which he hoped to obtain material for the investigation of star catalogues in general, and to secure the needed number of fixed points for the greater work. The plan for this work was first presented, in 1867, to the officers of the University at Bonn, and afterward at the general meeting of the Astronomische Gesellschaft, where the author also gave his views respecting the most convenient way of carrying it out. With some slight modifications they form the basis of the programme decided upon by the society at Vienna in 1869.

Argelander undertook a small part of the preliminary work for the execution of this scheme, but found that, at the age of seventy years, he was no longer competent to make the necessary observations, and he gave them over to his assistants, carrying on himself only the minor series. The main part of the treatise on the subject was printed only a short time before his death.

Argelander was less versed in the deeper theories of astronomy than in practical work. Hence those of his lectures that had a practical bearing were most interesting, and so searching was he that, whenever he found hearers, he aroused their earnest interest. He was fond of personal intercourse with his students, and would often walk with them, conversing on various subjects, questions of the day, etc. He would go into detailed and most entertaining discussions, for which his lectures afforded neither time nor a suitable public, and he could then consider the value of conjectural hypotheses to which he was no friend. The transparency of his character, the goodness of his heart, and his open, manly bearing will never be forgotten by his friends.

His active life was not wanting in distinctions. He wore orders conferred by Russia, Prussia, Sweden, and Baden. Numerous learned societies and academies made him an active, corresponding, or honorary member; those of St. Petersburg in 1826, of Berlin in 1836, of London (not more distinctly named) in 1846, of Stockholm in the same year, of Paris and Vienna in 1851, of Berlin in 1855, of Breslau in 1856, the Royal Astronomical Society of London in 1832, the Societas Fennica at Helsingfors in 1845, and the National Academy of the United States in 1864. He received the Demidoff prize of the St. Petersburg Academy while residing at Helsingfors, and the golden medal of the Royal Astronomical Society in 1863. The jubilee of his receiving the doctor's degree was made the occasion of a grand celebration in 1872. He was almost from its foundation a member of the official board of the Astronomische Gesellschaft, and presided at the meetings in Bonn and Leipsic.

Many positions were offered to him, but he preferred to remain at Bonn, while he always preserved an affectionate recollection of Finland. He devoted himself faithfully to the interests of the observatory, but was not fond of participating in affairs of administration, and was disinclined to public life. He was a welcome guest at the social gatherings of scientific societies.

Accepting, provisionally, D'Omalius d'Halley's estimate of the population of the earth, 1,195,450,000, M. H. R. Verneau calculates that forty-two per cent of the number are of the white race, forty-four per cent of the yellow race, eleven per cent are negroes, two per cent of the mixed Oceanic races, and one per cent Indians. By local distribution, the whites occupy twenty-two per cent of the habitable surface of the globe, the yellow races twenty-eight per cent, the negroes eighteen per cent, the Oceanians three per cent, and the American Indians twenty per cent. Hence, as distributed, there are found, on equal areas inhabited by them, one Indian, nineteen negroes, twenty-one Oceanians, fifty of the yellow races, and sixty-one whites. In point of religion, 400,000,000 of the earth's inhabitants are Christian adherents of various sects.

EDITOR'S TABLE.

SCIENCE AND WEALTH.

IT is admitted on all hands that the *rôle* of science in the modern world has been a splendid and beneficent one, and that if our present civilization differs for the better in many important respects from that of any preceding age the fact is mainly due to progress in scientific knowledge. The world had greater poets in past times than any it can boast to-day—at least this is generally assumed—and greater artists and greater metaphysicians; but who would wish to go back to the age of Shakespeare, or that of Dante, or that of Phidias and Plato? We all prefer a world in which an extensive knowledge of natural law prevails, in which natural forces have been bent, as we see them bent to-day, to human uses, and in which man has decisively gained the victory over the principal destructive agencies which once were a constantly recurring menace to his life and happiness. The basis, the firm foundation, of this civilization, which, in spite of any drawbacks attaching to it, we all prize so highly, is knowledge—sifted, verified, definitely acquired knowledge of the laws of nature. The adjustments of modern life are dependent in the most absolute manner on the facilities which scientific discovery has furnished for the production and interchange of commodities and for communication between individuals. And just as knowledge advances does society as a whole assume toward its component units more and more the character of an earthly Providence. Comte spoke of it in this character fifty years ago, and, with every passing year, the term becomes more and more appropriate. "Society," says Prof. Toy, in a recent article in the International Journal of Ethics, "has come to be an efficient moral guide and support. It has worked out great ideals which have become the heritage of a small but controlling section of the race. It offers great rewards for well-doing, and inflicts terrible punishment for ill-doing. The individual is not a moral orphan in the world; society stands to him in the place of a parent, with all of a parent's power and none of a parent's weaknesses." Society, we may add, aided by science, is every day improving and beautifying the environment into which the individual is born, every day surrounding his life with new safeguards, every day bringing within his reach wider ranges of thought and increased means of enjoyment.

All this hardly admits of question; or, if a question were raised, it would probably be not as to the existence of such a general movement as we have described, but as to whether a certain section of society is not more or less cut off from its benefits. That question doubtless deserves discussion, but we are not concerned with it to-day. What we wish to point out is that, in spite of the vast benefits which natural science is daily conferring on the world, the attitude of many of its principal beneficiaries is not a friendly one. We have heard an amusing but altogether authentic tale of a very wealthy and pious lady who cautioned a friend not to have anything to do with "Christian science," not because it was a system of quackery and delusion, but because it had the word "science" in its designation. "I confess, dear," she said most earnestly, "I don't like that word 'science.'" Can such things be, amid the blaze of nineteenth-century enlightenment? Yes, they can be and are. Not often, perhaps, do we hear the *naïve* confession, "I don't like that word science"; but proofs abound that multi-

tudes of presumably educated people, many of them living in luxury made possible only by scientific invention, dislike both the name and the thing. They dislike the exactness of science, dim as their apprehension of it may be; they dislike its methods; they dislike the standard it sets up—truth, conformity to fact, without regard to previously established opinions. The apostle of truth who preaches severe doctrine in the wilderness is not to their liking; give them one clad in soft raiment who preaches comfortable doctrine in a richly upholstered church. And how is it with the men into whose hands the practical applications of science bring measureless wealth? Do they, as a general thing, show any recognition of its importance to the world? Are they interested in aiding research? Do they determine that no one who has an impulse toward scientific discovery shall, if they can help it, lack the means of laboring in so noble a direction? Alas, no! The favorite direction for the rich man's wealth is toward the theological college. From the number and magnificence of the donations and bequests to theological colleges, in this country particularly, one would suppose that the age was starving for theological knowledge, or perchance that theology had produced the wealth that was the source of these benefactions. How the theological or denominational colleges treat science, in so far as they may adopt it as a branch of study, two or three well-known instances suffice to show—Dr. Winchell driven from the chair of Geology in Vanderbilt University; Prof. Woodrow from the chair of Natural Science at the Columbia (S. C.) Theological Seminary; and Prof. Toy, now of Harvard, from a position held by him in a similar institution at Louisville. As we write, Prof. Briggs, of this city, who, though not a student of natural science, believes in the application of scientific principles to questions of ecclesiastical history, is in danger of losing his chair at the Union Theological Seminary; while a Canadian scholar, Prof. Workman, of Victoria University (Methodist), is running a similar risk from an exactly similar cause. We have no wish to speak unkindly of theological colleges in general; some of them, as we know, are doing excellent work in certain directions; but we are strongly of opinion that bequests or donations to such colleges are not apt to advance the cause of science. That cause will no doubt gain ground more and more through the general advance of society, however much money our millionaires may devote to impeding its progress; but it might be greatly helped by judicious benefactions. A French *savant*, M. Cahours, has lately bequeathed the sum of one hundred thousand francs to the French Academy of Sciences for the purpose of assisting young men of a scientific bent of mind to pursue original researches or experiments for which they may not themselves possess the means. This we regard as one of the most hopeful ways in which wealth seeking a useful social application could be expended. Much work that would be valuable remains undone simply because the person possessing the germ-idea is unable, through lack of pecuniary resources, to develop it. Or the man with the idea puts himself in the hands of others, who, taking advantage of his poverty, make such terms as leave him with only a vestige of interest in the product of his own brain. There is room for much improvement in the attitude of men of wealth, and indeed of society at large, toward science; and, as Prof. Mendenhall showed last year in his address at Indianapolis, there is room for improvement in the attitude of men of science toward the community at large. The best fruits of science will not be reaped, and society will not undergo its great transformation, until, on both sides, the needed improvement is accomplished—until science receives the place of honor in the thoughts of all, and those who are

its ministers wait on their ministering with a due sense of the sacredness of their calling.

LITERARY NOTICES.

GOSPEL CRITICISM AND HISTORICAL CHRISTIANITY. By the Rev. ORELLO CONE, D. D. Putnams. Price, $1.75.

NEVER before was greater interest taken in religious problems. The Bible is the storm-center of modern philosophical, scientific, and historical discussions. The questions raised are of fundamental importance. They do not affect minor details only, but the very essence of the faith. The Bible used to be considered a book *sui generis*, whose statements must not be doubted and criticised, but must be accepted without question. Now it is asked: Who wrote the Scriptures? When were they written? Are they true? Manifestly, until these questions are answered it is wholly impertinent to ask us to accept these writings as inspired authorities. Nor are we willing to take the mere word of the Church on this subject, for the Church has made so many mistakes that its guidance can not be blindly accepted. We must be given facts and reasons upon which to rest our faith, and so biblical criticism has arisen. It is a modern product—not more than a hundred years old—but, like the other modern sciences, it is most important. It does not aim to destroy religion or the Bible, but rather to free them from superstition, and make them more credible, attractive, and influential. This is certainly the object of the book under review. Dr. Cone is well known as the President of Buchtel College, Akron, Ohio, and brings to the study of his subject a ripe scholarship, a chastened judgment, and a reverent spirit. He gives us the results of the best German criticism of the Scriptures in a most readable form. First of all, in a criticism of the text of the Gospels, he shows that "these writings were exposed to the fortune which has attended all the literary productions of ancient times; that the autographs were early lost, that the text was corrupted and interpolated; that a considerable time elapsed between their composition and the appearance of careful and accurate quotations of them, during which the changes to which the text was subjected are indeterminable; that, however, alterations, corruptions, and interpolations have not, in all probability, materially affected their essential, historical contents—that is, their accounts of the great teachings of Jesus and their representation of his life and character." One of the most important chapters is the second, which discusses the canon of the New Testament. Our author finds no evidence in the writings of the earliest Christian fathers—Clement of Rome, Barnabas, Hermas, Polycarp, Papias, Justin Martyr, and others—to justify the conclusion that the Gospels were considered by them as of exclusive authority. On the contrary, these writings, "after having remained unnamed and undistinguished in the mass of early Christian literature for about a hundred years, are found to have made their way by the beginning of the third century to a general recognition in the Church as exclusive historical sources of the life and teachings of Jesus." This conclusion is of immense importance, especially when it is remembered that the canon was not established by a careful critical examination of testimonies, but the Gospels were accepted simply on the evidence of a very uncertain tradition. In the third chapter, Dr. Cone deals with "the synoptic problem." The question is, Why do the first three Gospels contain so much matter that is *exactly* the same in all of them, while each of them, nevertheless, has much that is peculiar to itself? Several hypotheses have been framed to solve the problem: (1) It is held that the later writers copied from the earlier; (2) all drew from a common written source, or an original Gospel; (3) a fixed oral tradition was the primitive source. Our author thinks there are insuperable objections to all these theories. The eminent German critic Schleiermacher sought to explain the synoptic phenomena by the assumption of several sources, embracing only parts of the history, which were variously combined by the three writers of the Gospels. Mark and the Aramaic Logia of Jesus, which Matthew is said to have written, were among these sources. Hence our present Gospels of Matthew and Luke were largely derived from these sources. Dr. Cone adopts this view. He says: "The logia source written

by Matthew and understood according to Schleiermacher's interpretation of Papias and the priority of Mark, which may be regarded as an incontestable conclusion of recent gospel criticism, furnish the key to the solution of the problem of the relation of the synoptic Gospels." Mark, according to this view, wrote his Gospel "in the last years of the sixties," probably at Rome, from notes on St. Peter's sermon, the logia by Matthew, and oral tradition. We can only partially indorse this opinion. We doubt whether Mark furnished as much of the materials of our present Gospel as our author thinks; but his view of Matthew we may safely adopt. The Logia of Jesus, which Papias says Matthew wrote in Aramaic, the Gospel of Mark, and oral tradition doubtless constituted the substrata of our present Gospel, which was written in Greek some time between A. D. 70 and 100. Dr. Cone says that the Gospel, as it now stands, contains legendary matter. "Such are probably the accounts of the birth and infancy of Jesus, the details of the temptation in the desert, the episode of Peter's walking on the water, the story of the piece of money to be found in the mouth of a fish, the rending of the veil of the temple, the resurrection of the saints at the time of the crucifixion, and the corruption of the guard placed at the tomb." The author accepts the traditional authorship of Luke's Gospel, holding that it was written by St. Paul's companion about A. D. 90. We can not subscribe to this opinion, for neither the external nor the internal evidence seems to us to justify it. Luke probably furnished the substrata of the Acts and the third Gospel (both were written by the same person), which were subsequently wrought up into their present shape by a friend of Theophilus. The prologue to this Gospel, which Dr. Cone somewhat unaccountably ascribes to the hand that composed the rest of the book, differs from it entirely in its style, and is generally believed to have been added to the Gospel by a late *redacteur*. The work is composite in its character and the product of several hands. Davidson's view of this Gospel is more satisfactory than that of Dr. Cone.

The authorship of the fourth Gospel is the *pons asinorum* of biblical criticism. The man who holds that St. John the Apostle wrote it is *ipso facto* excluded from philosophical critics, and placed among the special pleaders for traditionalism. Both the external and the internal evidences are overwhelmingly against the Johannine authorship of the book. No tradition ascribes it to the apostle for a century after he is supposed to have written it, and this late tradition is wholly untrustworthy. There is no adequate evidence to show that it was in existence before Justin Martyr's day, A. D. 140. But, above all, the style, the theology, and the general character of the Gospel make it impossible to accept it as the work of John. It is rather the mystic musing of a Philonic philosopher, who may have belonged to the Ephesian school, and have got fragments of the apostle's teaching and woven them into his work during the first quarter of the second century. Dr. Cone nowhere shows more critical ability and philosophic insight and discrimination than in his cautious yet masterful discussion of the Johannine problem. He concludes that "the problem of the authorship of the fourth Gospel is not one to be solved offhand by radical criticism, or to be pronounced upon *ex cathedra* by conservative dogmatism. If the external evidences are indecisive of its early origin (and he thinks they are); if from internal grounds we can not regard it as the work of an apostle; if it plainly has a composite character—then the unbiased critic may still be just to the ancient tradition of the Ephesian Church and to the profound spiritual sayings of the Gospel in holding that, while on any hypothesis of its origin many critical problems remain unsolved, there is at least a strong probability for a Johannine nucleus in the book, for frequent 'words of the Lord,' handed down from the apostle without connection, probably, and without a historical setting, which have in this remarkable work found a literary embodiment in the midst of much mysticism, it is true, and overlaid by Greek-Christian, second-century speculations, but distinguishable from these by their unique quality and surprising originality."

After discussing, with much clearness and satisfaction, the eschatology of the Gospels, Baur's celebrated "tendency-the-

ory" of their composition, and the use their writers made of the Old Testament, the author considers the very important question, What is the historical *value* of the Gospels if the modern critical view of them be accepted? Are the foundations of Christianity sapped when these documents are shown to be ordinary human productions, with more or less error in them? The tyro in biblical criticism can alone take this superficial view of the case. Prof. Huxley well says, "The rule of common sense is, *prima facie*, to trust a witness in all matters in which neither his self-interest, his passions, his prejudices, nor that love of the marvelous, which is inherent to a greater or less degree in all mankind, are concerned." Any thoughtful student of the Gospels can apply this rule in separating the chaff from the grain in these writings, and Dr. Cone does it admirably. According to him, the logia by Matthew, which probably constitute the substance of the Sermon on the Mount (Matt. v–vii) and other such aphoristic sayings of Jesus, the parables, and the greater part of Mark, form the substrata of the Gospel history, and may be fully accepted. "In the midst of all the chaotic elements which the flood of oral tradition rolled along," he says, "is clearly discernible a historical grouping of salient facts—the appearance of the Baptist, the Galilean ministry of Jesus, the healings, the teachings, the travels with the disciples, the gathering multitudes, the conflicts, Cæsarea Philippi, the fateful journey to Jerusalem, Gethsemane, the trial and tragedy, the consternation of the little flock, and the mysterious birth of a great hope."

Criticism, therefore, "establishes the kernel of the history of Jesus in an inexpugnable position. It does not exclude God from history, but finds it no wonder that, since he has designs to work out in man, exceptional manifestations of his revealing spirit should betimes appear."

We consider this book one of the very best contributions which rational thought has made to biblical criticism. The style is clear and fluent, the arguments are cogent, the conclusions conservative, the spirit reverential, and the whole result reassuring. The radical critics may learn from it soberness, and the timid conservatives may find in it assurance and confidence. The book should have a wide reading among all those who are interested in the religious palingenesis now taking place in our midst.

BULLETIN OF THE UNITED STATES FISH COMMISSION. Vol. VIII, for 1888. MARSHALL McDONALD, Commissioner. Washington: United States Commission of Fish and Fisheries. Pp. 494, quarto.

TWELVE special papers form the contents of this volume, some of them having popular and commercial interest, while the rest can be made use of only by zoölogists. The first paper reports the Explorations of the Fishing Grounds of Alaska, Washington Territory, and Oregon during 1888, by the United States Fish Commission steamer Albatross, and is compiled from the accounts of Lieutenant-Commander Z. L. Tanner, commanding the Albatross; Mr. C. H. Townsend, naturalist; and Mr. A. B. Alexander, fishery expert, of the expedition. The results of hydrographic work, dredgings, and trials for fish at a great many places are given. Codfish were found often in abundance, and halibut, flounders, black cod, and rock-fish were also taken, besides some useless as food. The paper contains also information in regard to facilities for taking and marketing fish on the Pacific coast. Three full-page illustrations show the method of drying salmon practiced by the Alaska Indians; two more show the kind of sod houses occupied by the natives; there is a distant view of three captured sealing-vessels and a near view of one of them, and others, besides three folded charts. This paper is followed by an account of Explorations of the Alleghany Region and Western Indiana, by Prof. David Starr Jordan, which we have noticed separately. Some practical Suggestions for improving Fishing Vessels, illustrated with plans, are contributed by J. W. Collins. There is an account of The Sturgeons and Sturgeon Industries of the Eastern Coast of the United States, including the making of caviare, by John A. Ryder, accompanied by twenty-three plates. Over a hundred pages are occupied by A Review of the Serranidæ, by David Starr Jordan and Carl H. Eigenman. The family of Serranidæ includes the various species of salt-water perch and bass, and other important food-fishes. Ten species are represented

in the accompanying plates. An interesting chapter in the history of fish-culture is the record of several attempts at Transplanting Lobsters to the Pacific Coast, by Richard Rathbun. The volume contains also several shorter papers.

THE NEW RELIGION: A Gospel of Love. By E. W. GRAY. Chicago: Thorne Publishing Co. Pp. 423.

THE New Religion unfolded in these pages is an exposition of the doctrine of Christ that love is the law of life. The author holds that the introduction of this motive of growth differentiates the Christian faith from all antecedent beliefs. The Egyptian, Brahman, Buddhist, Greek, Roman, and Jew are spurred on by fear under inexorable law—"the gods of the old religion are not gods of sympathy and love."

In judging Christianity it must not be confounded with any parasitic "ism." Superstition must be stripped away, the dogmas of Church fathers and apostles disregarded until the teaching of Christ himself is reached. This is found to be greatly at variance with the commonly accepted notions of Christianity. "The practice of going into public for the express purpose of prayer and worship has no sanction in the New Religion," neither has a paid priesthood, nor public worship as such. The Church is overgrown with externalism which saps its life. Educational ministries are, however, productive of good, and the public meeting of the people beneficial for instruction. Another ecclesiastical excrescence is the undue value of organization. For the first two hundred years, Christians did without church or creed, "and it may well be doubted whether both the organization and the creed have helped more than they have hurt Christianity." Dr. Gray believes that Jesus was not God and man, but God-man, and his explanation of the Christ-nature is at least ingenious. He asks whether the domain of animated existence may not be extended, and suggests that, "for a specific and expressed purpose, an addition of another order of being was made." Christ was *sui generis*, a new variety. The transfiguration, resurrection, and ascension are received in their entirety as revelations of spiritual existence. The author holds that "if we accept Christianity at all, we must accept what is called the supernatural." Miracles are not contrary to the laws of Nature, but transcend them, and may be in agreement with laws still unknown.

Dogmas of later date than the creed are not gently entertained. "An instantaneous transformation of character" is "one of the chief postulates of the New Religion." This is effected not by faith, or redeeming blood, but by the compelling love of Christ. Dr. Gray points out that Christ teaches plainly a new and positive morality: "Do good to them that hate you"; "Lay not up for yourselves treasures upon earth." He insists that these directions are practical and obligatory for all Christians. Statistics are cited to show that one church controls $150,000,000 of property; another, twice this amount; and he dryly observes, "There is no scarcity . . . but the scarcity of love—the virtue of the second commandment." The author is never consciously evasive, but direct, as well as reverent in his search for truth.

THE PSYCHOLOGY OF ATTENTION. By TH. RIBOT, Professor of Comparative and Experimental Psychology at the Collége de France. The Open Court Publishing Co., Chicago. Pp. 121. Price, 75 cents.

THIS little work is devoted exclusively to an investigation of the mechanism of attention. The subject is divided into two distinct forms. The one, which is spontaneous and natural—the true primitive and fundamental form of attention—has been neglected by psychologists; while the other, which the author calls voluntary, is but an imitation, a result of training and education. It is derived wholly from spontaneous attention, and yet it is the only form to which psychologists have given much consideration. In this volume Prof. Ribot goes to the root of the matter in the emotional states of animals and young children; and he holds that it is only by a study of its primitive form that we can reach an intelligible explanation of the higher forms of attention.

In his chapter upon spontaneous attention, the author discusses its physical manifestations: vaso-motory phenomena, motory phenomena, or phenomena of expression; explains that its supposed effects are really its constitutive elements, that it is only the subjective aspect of the physical manifestations

expressing it. He treats also of that exaggeration of spontaneous attention known as surprise or astonishment. The chapter upon voluntary attention makes up the greater portion of the volume. The study of natural attention enables him to inquire into the genesis and mechanism of voluntary attention, and to arrive at some comprehension of it. He concludes the chapter with the statement that attention in no respect resembles an independent activity; that it is bound up with perfectly determined physical conditions, that it acts only through the latter, and is dependent on the same. The last chapter treats of morbid states of attention. The name of the author is a guarantee that the work is both interesting and instructive.

A System of Inorganic Chemistry. By William Ramsay, F. R. S., Professor of Chemistry in University College, London. Philadelphia: P. Blakiston, Son & Co. Pp. 700. Price, $4.50.

The word "System" in the above title has especial significance. It indicates that the treatise to which it is applied is characterized by a methodical arrangement. Taking the periodic classification of the elements as a basis, the author has undertaken to bring into the field of inorganic chemistry an orderly arrangement similar to that which has prevailed for more than twenty years among the compounds of carbon. This, he says, owing to traditional and commercial influences, has not been done before in any book written in English. After a short historical introduction the elements are considered in order, and within a moderate compass. Next their compounds with the halogens are taken up. The author names as a defect of many previous books the ignoring of the double halides, except in a few special instances; accordingly, he has taken pains to have these compounds well represented. The oxides, sulphides, selenides, and tellurides follow next, "double oxides, such as sulphates, for example, being considered among the compounds of the simple oxides with the oxides of other elements." Other features of previous books which Prof. Ramsay has aimed to avoid are magnifying the difference and obscuring the relationship between acid hydroxides and basic hydroxides, neglecting the borides, nitrides, etc., and giving pre-eminence to methods of preparing compounds which are of commercial utility over other methods which have fully as much scientific importance. After the account of the oxides, a few chapters are occupied with the borides, carbides, and silicides, and the nitrides, phosphides, arsenides, and antimonides; and in these the organo-metallic compounds, the double compounds of ammonia, and the cyanides are considered; while a short account is given of alloys and amalgams. "The chemistry of the rare earths, which must at present be relegated to a suspense account, is treated along with spectrum analysis in a special chapter; and the systematic portion of the book concludes with an account of the periodic table." The concluding part of the volume deals with manufacturing processes, which are so grouped that substances generally manufactured under one roof are treated together. In regard to the adaptability of his system to teaching the author says: "Having used it for four years, I am perfectly satisfied with the results. For the student, memory work is lightened; for the teacher, the long, tedious description of metals and their salts is avoided; and I have found that the student's interest is retained, owing to the fact that all the 'fire-works' are not displayed at the beginning of the course, but are distributed pretty evenly throughout."

The Iron Ores of Minnesota. By N. H. Winchell (State Geologist) and H. V. Winchell. Minneapolis: The Geological and Natural History Survey of Minnesota. Pp. 430.

This extended and practical book is due to a State law directing the Geologist to make examinations and reports in regard to economic products. The first part of the volume describes the distribution and geology of the iron ores of Minnesota so far as they are known. These comprise magnetites, hematites, and some limonites. Next the methods of exploration and mining that are employed in the State are described, and accounts are given of the principal mines. There is a chapter on the facilities for transporting and marketing the Minnesota ores, another on the origin of the deposits described in the first part of the report, and a

bibliography of the origin of iron ores, which occupies seventy-five pages. The volume contains also lists of mining companies and of leases of mineral lands, the mining laws of Minnesota, a glossary of mining and geological terms, etc. There are several colored plates showing microscopic sections of minerals, and other plates showing plans of mines, the general appearance of certain rocks, and the mining machinery made by various manufacturers, and there are several folded maps.

MECHANISM AND PERSONALITY. By FRANCIS A. SHOUP, D. D. Boston: Ginn & Co. Pp. 343. Price, $1.30.

BY his sub-title the author describes this work as "an outline of philosophy in the light of the latest scientific research." Philosophy has not been so much affected by any movement in all the centuries of its history as it has by the activity of scientific thought in the last two or three generations, and this book is designed to inform the general reader as to what modification metaphysics has undergone in consequence of the scientific upheaval. "It is quite natural," says Dr. Shoup, "that they who are once taken with the experimental method should think they have no time, and show so plainly that they have no patience with the old hair-splitting, foggy metaphysic. And yet it will hardly do to cast contempt upon the old thinkers. The seductive path of positive science leads off into regions of speculative thought at numberless points; and if Science does not already know that she is caught in the toils of Metaphysics, it is only because she does not yet fully recognize her contact with the ultimate." In the early part of the volume Dr. Shoup sketches the latest results of physiological research upon the human mechanism in its relation to the psychic powers. He then devotes a chapter to the chasm between mechanism and consciousness, in which he states that the so-called scientific opinion that matter is the cause of mind is really unscientific and is not held by the leading men of science. He quotes against materialism Tyndall, Huxley, Spencer, Maudsley, Du Bois-Reymond, and Pasteur—all explicitly. Passing to the consideration of personality in its psychical aspect, Dr. Shoup treats each of the mental faculties in succession, closing with a discussion of ethical feeling, and a consideration of the infinite personality. The author states that the metaphysics of his work is in the main the Lotzian phase of Kant. The style of the book is attractive, and the author evidently has the too uncommon ability to appreciate the work of both metaphysicians and scientists.

The *Report of the State Mineralogist of California, William Irelan, Jr.*, for 1890, is a large octavo volume, which contains, besides the general report of the mineralogist, a large number of special reports on the several counties of the State, prepared by assistants in the field, and other special papers. Among the latter papers are an account of the asphaltum mine of Ventura Asphalt Company, by E. W. Hilgard; Lead Smelting, with figures of apparatus, by F. C. von Petersdorff; Location of Mines, by R. P. Hammond, Jr.; Quicksilver Mining, by J. B. Randol; Mining of Gold Ores in California, by J. H. Hammond; Pico Cañon Oil-fields, by Edward North; and Auriferous Beach-sands, by Dr. H. De Groot. The volume is illustrated by diagrams and photographic views, and is accompanied by six folded geological maps.

The *Annals of the New York Academy of Sciences* for November, 1890, being Numbers 9 to 12 of Vol. V, contain some two hundred pages, which are wholly devoted to Coleopterological Notices, second part, by Thomas L. Casey. A plate accompanies the text. The *Transactions* of the Academy for October, 1890, comprise the proceedings at four meetings, and abstracts of papers by Dr. John I. Northrop on The Geology of the Bahamas, by Dr. H. T. Vultó on the analysis of grains and cereals, and by Dr. H. Carrington Bolton on musical sand in the Hawaiian Islands and in California.

Volume XII of the *Transactions of the Kansas Academy of Science* covers the twenty-second and twenty-third annual meetings of the Academy. The volume contains a large number of papers, most of them brief, dealing with a wide variety of scientific topics. Among the most important are two by Prof. F. H. Snow, describing his very successful operations in disseminating contagious

disease among chinch-bugs. Another useful paper, by George E. Curtis, shows the utter untrustworthiness of the weather predictions, made for a year ahead, by a local weather prophet. Some other topics treated are Artesian Wells in Kansas, Cements manufactured in Kansas, Notes on Gophers, and the Manufacture of Binding-twine.

A service has been done to persons interested in forestry by the publication of *Insects injurious to Forest and Shade Trees*, by Prof. *Alpheus S. Packard*, being the fifth report of the U. S. Entomological Commission (Department of Agriculture, Washington). The volume has 957 pages, and its contents are arranged under the names of trees. The body of the work is introduced by a chapter of general information, which includes descriptions of various insecticides, and of means for applying them to trees. The text is illustrated with 306 cuts and 40 plates, some of the latter being colored. There are separate indexes of insects, of plants, and of authors quoted.

A sketch of what has been done toward inventing a practical air-ship is given in the lecture on *Aërial Navigation*, by *O. Chanute*, C. E., reprinted from The Railroad and Engineering Journal as a pamphlet. Mr. Chanute sketches the progress in ballooning since the time of Montgolfier, and describes also the attempts that have been made to construct mechanical flying machines. He believes that dirigible balloons, which have already attained a speed of fourteen miles an hour, will before long be driven at the rate of twenty-five to thirty miles, and says that much greater speeds may, perhaps, be attained eventually with aëroplanes.

Bulletin No. 19 of the U. S. Coast and Geodetic Survey is a report by Ensign *J. C. Drake* on *The Sounds and Estuaries of Georgia*, with reference to oyster culture. It embodies an examination of all the waters under the jurisdiction of the State of Georgia in which oysters grow naturally, or in which they probably could be made to grow. The extent of each body of water is given, the character of its currents and its bottom, the area of any existing oyster-beds in it, and the density of the water. Seven large folded charts accompany the text.

The *Zoölogical Articles* contributed to the Encyclopædia Britannica by *E. Ray Lankester* have been reprinted in a volume with kindred articles by eminent specialists, which are also taken from the Encyclopædia (Scribners, $5). Dr. Lankester states, in the preface, that the purpose of the volume is to make these monographs readily accessible to university students. His own articles are those on protozoa, hydrozoa, mollusca, polyzoa, and vertebrata; the others are, Sponges, by Prof. Sollas; Planarians, by Prof. von Graff; Nemertines, by Prof. Habrecht; Rotifera, by Prof. Bourne; and Tunicata, by Prof. Herdman. These together form a treatise on a considerable section of the animal kingdom. In the reprint a few errors have been corrected, and some notes and illustrations have been added.

The *Transactions of the Iowa State Medical Society, for 1890*, contains the proceedings of the thirty-eighth annual session of the society, held in April, 1890, and a large number of papers presented at that meeting, with the discussions upon them. A subject of popular interest, treated in one of these papers, is pension examinations, the burden of the paper being a complaint that examining surgeons are required to perform several hours of professional labor for one or two dollars. The address of the president was on the question, Should persons who have inherited disease detrimental to society and the State be allowed to marry? the negative side being taken.

Johnson's comprehensive treatise on *Surveying* (Wiley), first published in 1886, has reached its seventh edition. Some changes have been made each time a new edition has appeared, and this issue contains a great many. To the part on surveying instruments have been added descriptions and cuts of the architect's level and several other instruments; the table of magnetic declination formulæ has been replaced with the new table of the U. S. Coast and Geodetic Survey; the isogonic chart of the United States has been redrawn and brought down to 1890; the chapter on land-surveying has been recast, and considerable new matter concerning monuments and the rules governing the resurvey of lands has been added; the description of the U. S. Land Surveys has been rewritten and expanded; a method of running out parallels of latitude, with suit-

able tables, has been added; also, tables and descriptions by which an observation for azimuth may be made on Polaris at any hour; and a description of Porro's telescope has been inserted in the chapter on topographical surveying.

In the *Report of the Smithsonian Institution, for 1889*, the secretary states that the Records of Scientific Progress in each of several branches of science, which the Institution has published for some years, have been discontinued. In place of these there will be published "memoirs of a special interest and permanent value, which have already appeared elsewhere, and which are sufficiently untechnical to be readily apprehended by readers fairly representative of the intelligent and educated class among the constituents of the members of Congress, by whom they are chiefly distributed. Among the subjects treated in such papers appended to this report are, Hertz's researches on electrical oscillations, progress of meteorology and of anthropology in 1889, national scientific institutions at Berlin, movements of the earth's crust, geographical latitude, last steps in the genealogy of man, time-keeping in Greece and Rome, the life-work of Pasteur, and memoirs of Fleischer and Kirchhoff.

An Address on behalf of the Indians has been issued by representatives of the *Religious Society of Friends* for Pennsylvania, New Jersey, and Delaware (Friends' Bookstore, Philadelphia). Its object is to show that our troubles with the Indians of late years have been due to aggressions of frontier whites upon the Indians, and to faithless and neglectful treatment by the officers of the War Department and the Indian Bureau. The address is temperate and dignified in tone, and its statements are supported by extracts from Government reports, the words of intelligent Indian chiefs, and the testimony of persons who have worked among the Indians.

A little volume of "essays against superstition" has been published by *E. C. Kenney*, under the title *Ghosts, Devils, Angels, and Sun Gods* (the author, Truxton, New York, 25 cents). He explains the origin of beliefs in supernatural beings among primitive men, and shows that many of these myths have persisted in more or less changed forms to the present day. He interprets the story of the Garden of Eden and that of the Deluge on a natural basis, draws a parallel between Gautama and Jesus Christ, and discusses the fatal number thirteen and the mystic three. The closing chapter is an arraignment of sectarian control over education. The book is temperate in tone, and is in agreement with the results of modern investigation.

For the first time in its history the *Report on Medical Education*, issued by the *Illinois State Board of Health*, embraces the medical institutions of the whole world. This is a feature that will be an assistance to medical boards that have to determine the value and validity of a medical diploma. As regards medical education in the United States, the report shows the marked changes for the better that have taken place in the past ten years, and it is seen that more progress will be made within the next two years. The report shows a marked increase in requirements as to preliminary education during the year 1890. It shows also that the movement for four years' study and three courses of lectures is an assured success, and a list is given of the colleges that have adopted or will soon adopt the requirements of longer terms of study.

Plain Talks on Electricity and Batteries, by *Horatio R. Bigelow*, M. D. (Blakiston), is a manual for physicians, describing the medical use of electricity, and the instruments and apparatus employed in this branch of therapeutics. Various forms of electrical machines, meters, and electrodes are figured, and the names of the makers are given. There are also figures showing the mode of applying electricity to various parts of the body.

A monograph on *The Modern Antipyretics* has been published by *Isaac Ott*, M. D. (E. D. Vogel, Easton, Pa.). It embraces a discussion of the nature of fever, a description of the chemical character and the physiological action of pyridin, quinolin, kairin, and thallin, a statement of the therapeutic action of each of the known antipyretics, and some observations on the value of antithermics in typhoid fever.

A pamphlet giving a brief history of

The Patent System of the United States has been published by *Levin H. Campbell* (the author, Washington, 50 cents). Mr. Campbell introduces his subject with a chapter on the early English patent system, and goes on to tell of the appearance of the system in the American colonies, and the changes in organization and practice that it has undergone in the past century.

The English Series, by *W. H. Maxwell*, has been completed by the publication of *Advanced Lessons in English Grammar* (American Book Company, 60 cents). This book is designed for a high-school or the last two years of a grammar-school course, and besides its use as a text-book it is intended to be available for reference when difficulties are met with in composition exercises, or in the critical study of literature. The first three chapters give a bird's-eye view of the parts of speech and of the construction of the English sentence. The usual divisions of English grammar are then taken up in succession. Etymology is defined as treating of the classification, inflection, and formation of words. The chapter given to the last of these topics includes lists of English, Latin, and Greek affixes, and models for word-analysis. There is a chapter on Economy of Attention, based on Herbert Spencer's Philosophy of Style, which contains certain things that can not well be placed elsewhere. The author is Superintendent of Public Instruction in Brooklyn.

The method adopted by *David Salmon*, the author of *Longman's Primary-School Grammar* (Longman's, 35 cents), is that of "making children familiar first with the thing, then with the name." Accordingly, the child is first required to pick out all names of persons in a given series of sentences, and the other requirements of the first exercise are: "Give the names of ten boys; ten girls; ten persons whom you know; ten persons about whom you have read." After ten similar exercises on nouns of different sorts the first definition is given to be learned. The author says that he has made his definitions so that young children can understand them, although in doing so he has made some of them unsatisfactory to a logician.

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POPULAR MISCELLANY.

Spontaneous Languages.—We noticed, several months ago, a deeply interesting study of the spontaneous development of language in children, by the Hon. Horatio Hale. The same phenomenon—tantamount to the creation of an original tongue—has been observed by other persons; among them, Miss Watson, of Boston; Dr. E. R. Hun, of Albany; Archdeacon Farrar (in the case of Indian children left by themselves for weeks together in Canadian villages); and by M. Taine, in his work *De l'Intelligence*. Mr. W. J. Stillman has recently communicated to Nature observations made by him upon his son several years ago, when he was under the care of an Italian nurse. As the child's utterances took shape it was found that he repeated certain sounds with a definite meaning, and soon coined a small vocabulary for himself, comprising words for bread, water, milk, etc. The first word distinguished was *chumbhoo*, for water. Then in a few weeks he began to couple the Italian words with his, and said *chumboo-aqua*. Little by little he dropped his own words and began speaking only Italian. Recently, when on a visit to Crete, Mr. Stillman met a boy who had formed for himself a similar language, with the same word for water as his own son had invented. Mrs. Agnes Crane cites in a later number of Nature the case of a nephew of Dr. George Gablentz, a well-known Sinologist, who, before he learned his mother-tongue, called things by names of his own invention. The constant elements were the consonants, while the vowels were varied and employed as they were deeper or higher to denote greatness or smallness. The root for round

objects was *m—m;* a watch, plate, and the moon were *mem*, a large round dish or table was *mum*, and the stars were *mim mim mim;* an ordinary chair was *lakail*, a great arm-chair *lukull*, and a little doll's chair *likill*. The Rev. J. C. Ball, a distinguished philologist, and his young brother, when six or eight years old, had names of their own devising for their tools and toys. Mary Howitt's elder sister, Anna, did not learn to talk till she was four years old; and even then, having but few words, the children had to coin their own. To sneeze was *okis-how*—a sound, she thinks, one of their parents must have made in sneezing. By a similar onomatopœia, an American child called cat *mea;* in another child's vocabulary, the extraordinary trisyllable *shindikik* designated that animal. The association of ideas and extension of meaning are often very suggestive—viz., *migno-migno*—water, wash, bath; *waia waiar*—black, darkness, negro. It is interesting, Mrs. Crane adds, to note the continued use of Mr. Stillman's boy's own name for water as a means of identifying the acquired Italian *aqua* for the same object, as frequently happens with adults struggling to express themselves in a foreign tongue. Reduplication seems also to characterize these child-languages like those of some savage tribes, and plurals are formed by repetition.

Botany in the Harvard Museum.—The provisions for the permanent display of the botanical section of the Harvard University Museum are nearly complete, and will be unusually comprehensive. The exhibition is planned to contain both dry and alcoholic preparations, representing nearly all the botanical regions. The genera of North America will be most completely illustrated, while the principal groups from other parts of the world will be properly related to them in accordance with an educational plan. The illustration of the economic plants of this country will be extended through all the stages of development, and will be a prominent feature. A unique feature in the department of imitative specimens will be the collection of glass models, which have been prepared after a secret method by Herr Blaschka. They exhibit the whole microscopic structure with the different phases of growth accurately in details, and in some cases very largely magnified. The collection has also been given a set of duplicates from Columbia College representing the South American collection of Dr. Morony. The exhibition-rooms will be connected by passage-ways with those of the Zoölogical Museum on one side and the mineralogical section on the other side, and this in turn will be connected with the proposed corner-piece extending to the Peabody Museum; so that there will be a quadrangle with an unbroken circuit through those parts of the University Museum which are planned for public exhibition.

Resources of Honduras.—Mr. W. Pilcher gave to the British Association the results of his observations in Honduras during three months when he traveled on mule-back over a thousand miles, chiefly through that part of the country lying on the Pacific slope of the Cordilleras. On the Guayape and Jalun Rivers, in Olancho, the gold-washing provides an easy living for the natives. At the old Spanish mines of Opoteca and Yuscaran the mining camps of the Americans and Germans are at full work. Tropical vegetation abounds in the beautiful and fertile valleys and plateaus, and coffee, rice, maize, sugar-cane, bananas, plantains, guavas, oranges, lemons, and other fruits are continuously produced without fear of frost or adverse seasons. Herds of cattle and native horses are scattered over the country, and Honduras, with its natural advantages and its proximity to New Orleans, presents good opportunities to the foreign settler for the successful employment of his capital in the raising of cattle and the production of the fruits of the country.

Prof. Brooks's Studies in Oyster-culture.—Prof. H. Newell Martin refers the beginning of the scientific culture of the oyster to a paper by Prof. Brooks, which appeared in the first number of the Studies from the Biological Laboratory of Johns Hopkins University, "On the Development from the Eggs of a Certain Mollusk." It was followed in the next year by a treatise on the development of some fresh-water mollusca; and during the same year another member of

the university endeavored, at the instigation of the Fish Commission, to discover the young oysters and learn their mode of life. The first effort failed, because the young oyster was looked for between the shells of its mother, where it was not. Then, in 1879, Prof. Brooks undertook the search on the invitation of the Fish Commissioner for Maryland. Within twenty-four hours of his arrival at Crisfield, he discovered that the American oyster is not nursed within the shell of the parent, but shows an early independence; and that it is possible to take their eggs from oysters and fertilize and rear them artificially, as is done with the eggs of shad and trout. "These two discoveries, based on previous investigation of the development of mollusks which have no commercial importance, made a new starting-point for the study of the oyster. It was impossible to catch and study in continuous development the microscopic, embryonic oysters scattered throughout the Chesapeake Bay; but, once we could hatch the oyster in the laboratory and study its growth and life conditions, a very important step forward would be made. It was proved that we could get young oysters in incalculable numbers at a very small cost, and, far more important, an opportunity to investigate the life conditions of the young oyster would be given. To carry on the growth of the artificially hatched young oysters a steady supply of fresh sea-water was needed. This the university provided the next year by the purchase of a small steam-engine and a complete outfit for the breeding of young oysters on a small scale." Before the party left Crisfield, in July, 1879, they had established the two leading facts that the eggs of the Maryland oyster are thrown out into the bay to be fertilized at random, and that it is possible to fertilize and hatch thousands of them in a watch-glass; in fact, that in a few buckets of sea-water one could hatch enough eggs to supply spat for the whole Chesapeake Bay.

Building Homes.—A beaver in captivity, says Chambers's Journal, will build a dam across the kitchen, making it of sticks and brushes, with a charming air of doing the best he can. The nest-building of birds has also a delightful air of contrivance about it. One likes them for the marvels they do with bits of grass and rag and wool. There is human nest-building too; but, considering their resources, the birds are before us in the beauty and utility of their work; while in contrivance the beaver in the story leaves us nowhere. Our house-building corresponds to the nest-building of the birds. It is the preparation of our home: utility and beauty are to be as guiding lines in arranging our plan. Let it be remembered that we are not contriving a furniture mart or a *bric-à-brac* shop, or even a place on view, but a house to be lived in, every room and part of which is to be made enjoyable. It is greatly a matter of common sense and good taste; these produce better results than the check-book and the complete house-furnisher. The moneyed system results in a mansion complete, from a grand piano down to a cat and a duster. The system of contrivance boasts of having secured all one likes best, and all in good taste. The planners and contrivers are the true nest-builders. After duly considering the whole matter, the writer concludes that "our hints resolve themselves into two principles: arrange the house not by rule or custom, but for the use of each room; and let beauty unite with use in every part."

The Massachusetts Institute of Technology.—The history of the Massachusetts Institute of Technology is traced by Mr. Augustus Lowell in a commemorative address on the occasion of its twenty-fifth anniversary, June 3, 1890. It was opened in 1865, under the direction of Prof. W. B. Rogers, with twenty-seven students; it has now, after having suffered a decline in the years following the financial crisis of 1872, more than nine hundred students. A laboratory of general chemistry was introduced almost at the outset. The Rogers Laboratory of Physics, where the student could make observations and conduct measurements for himself, followed soon afterward. In 1871–'72 a scientific expedition of students and instructors went to the Rocky Mountains, and brought back with them from California apparatus for a laboratory of mining and metallurgy—the first proper concern of the kind devoted to purposes of instruction in the world. A laboratory of steam engineer-

ing was established in 1873, a system of shop-work in 1876, a laboratory of applied mechanics in 1881, the germ of a biological laboratory was introduced in 1884, and a laboratory for a course of electrical engineering was instituted in 1883. The last study is treated as dependent on mechanical engineering, and the recognition of laboratory work in mechanics as an essential feature of a proper training in any branch of the engineering profession is considered the last contribution of the Institute to the philosophy of scientific and technical education.

Petroleum Fuels.—Petroleum is defined by Prof. William Robinson as, in the widest sense of the term, comprising not only the mineral oils found in the earth's crust, but also the oils obtained by the destructive distillation of coal and bituminous shale. These complex liquid hydrocarbons vary in appearance from that of clear, light kerosene oils to heavy, dark-greenish slush or semi-fluid slime. After the volatile or lighter oils have been driven off from crude petroleum, the heavy oil left is known as *residuum* in America; in Russia it is called *astatki*. This *astatki*, or heavy petroleum refuse, is an excellent liquid fuel, and is at least twice as good as ordinary coal for steam-raising purposes. The light lubricating oils, intermediate oils, and kerosene or ordinary lamp oils are all being used at the present time instead of coal-gas in the cylinder of the internal-combustion engine. In some cases the heavier oils are converted into an oil-gas, which, when cooled, is admirably adapted to drive gas-engines. Other internal-combustion engines, as, for instance, the Priestman, Akroyd, and Knight engines, use common burning oils directly, and act as their own gas generators. Prof. Robinson urges that such dangerous and highly volatile hydrocarbons as benzoline, gasoline, and petroleum spirit should not be used as fuel in gas-engines. The long series of accidents so frequently attending the use of these light, inflammable vapors have done more than any other one thing to retard the development of this class of prime motors, by prejudicing the public mind against the appearance of oil in any shape or form. This volatile spirit may, however, act with safety as an evaporating agent instead of steam, as in the Yarrow spirit launches, where it is used in the internal parts, and provision is made against leakage, while ordinary burning oil generates the heat. It will thus be seen that liquid hydrocarbons, such as common petroleum oil, may be employed in prime motors as a substitute for either coal or steam or both. It is becoming generally recognized that for large powers, notwithstanding some advantages, the ordinary vaporizers in petroleum oil-engines are difficult and troublesome to work with. In fact, for large engines the practical plan obviously is to convert oil into gas by means of a gas-producer. Oil-gas, when cooled, can be used with great economy in the engine cylinder. Further, a very decided saving of fuel may be effected by this combination of oil-gas producer with the internal-combustion engine, in place of the boiler and steam-engine, in many places where suitable oil is cheap or plentiful, or where intermittent work is required. On the other hand, more heat may be produced by the direct combustion of liquid fuel with dry steam and air than by converting the oil into gas before using it as a fuel. Oil-gas is a safe, rich, permanent gas made from petroleum oil, and burned with excellent results in the gas-engine cylinder.

Improved Ventilation.—According to Mr. D. G. Hoey, the first attempt to apply really scientific principles to ventilation was made by Sir Humphry Davy in 1811, and nothing better has yet been offered. Davy proposed to ventilate the House of Commons by admitting fresh air through numerous holes in the floor and carrying off the foul air by tubes in the ceiling leading directly without, heated to promote rapidity of discharge, while the doors and windows were kept closed. The scheme failed in practical application because of defects in mechanism. A method based upon the same principles is proposed by Mr. Hoey, and has been applied in certain buildings in Glasgow. In it, for the admission of the fresh air without currents or draughts, a dado, about three feet high, is fitted at conveniently available parts around the room, with a narrow space between it and the wall. On the top of it wire gauze or perforated metal is fixed in an inclined position (to keep things from being put upon it). The fresh air is

introduced into the dado space at a low level and in a lateral direction to promote diffusion, through a number of inlets from the outer atmosphere along the whole line. The total area of these inlets is proportioned to the area of the hot-air shaft provided for carrying off the impure air. The total space inclosed by the dados is much greater than the total area of the inlets from the outer atmosphere; and by this means the entering air is made to spread itself slowly through the interior of the reservoir, and to percolate gently through the gauzes so as to permeate the atmosphere of the room by gentle diffusion, instead of entering in a stream. In winter the air admitted may be warmed by a heating surface of pipes fitted along the length of the dado. For carrying off the impure air, a chimney of suitable capacity is provided, with a close-throated fire grate; or a connection is formed with any existing perpendicular flue. There should be an opening in the room, at a high level, into an outlet tube communicating with the perpendicular column of rarefied air in the chimney or flue. When a suitable chimney or upright flue is not available, the same results are produced by a suitable tube erected above a skylight in the roof of the hall, in which a current may also be promoted by means of a Bunsen burner.

Labor as a Means of Human Improvement.—The remark which has been a long time current is re-enforced by the latest studies, that the prevailing and dominant people, races, or nations, and the flow of superior human energy have always come from the cold, bleak, inhospitable regions of the north. Notwithstanding physiology indicates a tropical or subtropical origin for mankind, man in the tropical regions makes no advance, but tends, on the whole, to decline; and when men from the temperate zone settle in tropical regions, they are very liable to become enervated. The probable reason for this tendency is that living in such regions is too easy, and that the conditions prevailing there do not afford the stimulus to the exertion without which it is impossible to keep up vigor. So, when, anywhere, a hard-working, active people meet with fortune and settle into a life of ease, they begin at once to weaken. In England, it is the common people who are multiplying rapidly and swarming all over the earth; while the aristocracy can not even keep up its stock, but has to be refreshed from time to time by the interpolation of fresh blood. These facts are used by Prof. Williams to enforce the maxim that every human being should earn his daily bread by daily work, and that the inheritance of such an amount of wealth as shall render a man or a woman a mere purposeless pleasure-seeker is a most degrading curse.

Aniline Photographs.—Analogous to the photographic process with the salts of silver is the production of pictures by a similar process with the aniline colors. As described by Messrs. Green, Cross, and Bevan, in the Society of Arts, the simplest method of producing a picture in any of these colors is based upon the fact that they all fade more or less on exposure to sunlight. Prints obtained by exposure to sunlight of paper coated with eosine and methylene blue were exhibited by the authors, in which the gradations of shade were exactly reproduced; those parts which received the most light were the most bleached, whereas the shadows of the object had protected the parts of the paper beneath them, and the depth of the shadow of the original was thereby reproduced. These pictures have no practical value, because they are destined to be obliterated by the gradual fading out of the whole surface. In the diazotype process, the picture is fixed by causing a compound to be formed which will resist the further action of the light. The process starts with the yellow body called primuline—a substance constituted with ammonia, having one of the hydrogen atoms replaced by a complex group. It combines with nitrous acid to form a diazo compound, and this, like the other diazo derivatives, exercises a constructive or synthetic reaction with the amines and phenols, with which azo-coloring matters are formed. The essential conditions of primuline photography are that the reactions take place with primuline after its application to any surface or material as a dye, without affecting its union with the material; and that the diazo derivative produces the photo-sensitive in the highest degree. The prints obtained are positive, the light and

shadow of the object being exactly reproduced in the colored picture. Natural objects, therefore, of convenient form, such as leaves, may be photographed directly; reproductions from camera pictures require glass positives, or positive paper prints made transparent in the usual way with vaseline. A second process is based upon the peculiar properties of the diazo derivatives of the coal-tar bases, in which the light plays a constructive part in the development of a colored picture. When the diazo compounds are treated with an alkaline bisulphite, they are converted into the diazo sulphonates, on which the action of light is to set free the diazo group from its combinations, but which do not react with phenols and amines. The mixture of a diazo sulphonate with the latter is unattended by any color reaction; but, on exposure to light, the diazo group being set free in presence of a phenol, the development of an azo-color takes place with equal step. In the process based on this reaction, the photographic surface is a mixture of a diazo sulphonate with the alkali compound of a phenol applied to any suitable material. On exposure to light under a transparency, development of color takes place in proportion to the quantity of light transmitted, giving, therefore, a reversed reproduction, or negative picture. When printed, the unattacked mixture is dissolved away by copious washing, and leaves the picture, already developed in the azo-color, which is relatively insoluble, permanently fixed upon the fabric or material. The primuline process is simple. It can be practiced with the minimum of apparatus, requires no technical training, and the results are striking and pleasing.

Processes for sterilizing Milk.—The report of Messrs. W. T. Sedgwick and John L. Batchelder, Jr., concerning the milk-supply of Boston, shows that milk drawn directly from the healthy cow is ordinarily free from bacteria, or sterile. It is, however, so rapidly contaminated in the act of milking, and is itself so favorable a medium for the growth of bacteria, that even "pure country" milk contains hundreds of bacteria per teaspoonful. The time required before this can be distributed in the city is so great that milk arriving by rail in Boston contains about 300,000 per teaspoonful, while that taken from wagons or sold in groceries is older and shows from one to ten millions. Mrs. Ellen H. Richards and Mrs. Mary Hinman Abel, who have made an especial investigation of the subject for Mr. Edward Atkinson, find the conclusions forced upon them that a large percentage of milk in daily use is liable to contain disease germs which may under favorable circumstances be communicated to the consumer; and that even healthy milk is a highly putrescible substance, which in its raw state offers a most favorable medium for the culture of many kinds of bacteria that grow in numbers and rapidity, depending principally on the surrounding temperature, and that in the digestive tract, especially of young children, in warm weather this partly decomposed milk leads often to fatal results. Various chemicals have been used to neutralize the acids resulting from the activity of these bacteria, but they have one and all been condemned as injuring the milk or as deleterious to the stomach. It is at present agreed on all hands that only by the application of heat can all this germ life be destroyed and the milk made safe without injuring its food value; and numberless experiments have been made to determine how high a degree of heat must be employed and how long it must be continued. This process is known as sterilization. By the ordinary methods in use considerable changes are wrought in the milk by sterilization; and means have been sought to destroy the bacteria, if possible, at a temperature that would leave the milk unchanged in odor, taste, and appearance. Several processes for this purpose are mentioned in Mr. Atkinson's paper; and it has been found that the object is accomplished by restricting the temperature to 140° Fahr.

Observatory Work at Harvard.—The Director of the Astronomical Observatory of Harvard College calls attention in his annual report to the need of a fire-proof building for the storage of photographic plates. The observatory has received in the last year about nine thousand such plates—some taken in Peru, some in California, and some in Cambridge, and it has in all about twenty-seven thousand of them. They represent the entire sky from the north to

the south pole, the greater portion of it being covered several times; and they show the spectra as well as the positions of the stars. A large part of the charts and nearly all the spectra are unique, not having been photographed elsewhere. Much time has been devoted at the three stations of the observatory to visual observations of the colors and markings of the planet Mars. A number of the so-called canals were recognized, but only one of them was seen to be double. The best means of photographic enlargement of astronomical observations have been studied. Investigations have been conducted with regard to the meteorology of the globe, with particular reference to cloudiness and other phenomena affecting the choice of astronomical stations; the fundamental principles of astronomical photography; the great nebulous region of Orion; the best form of standard light, and other details of quantitative photographic work.

Extension of the English Coal-fields.—A discovery of coal has been made near Dover which promises to mark a new era in the industrial development of England. It is full of interest, not only from the commercial point of view, but also, as Prof. Boyd Dawkins, who had much to do with it, remarks, because it is the story of a scientific idea originated many years ago, taking root in the minds of geologists, developed into theory, and ultimately verified by facts. The physical identity of the coal-bearing districts of Somerset on the west with those of northern France and Belgium on the east was recognized by Buckland and Conybeare, as far back as 1826, as well as the fact that the coal-measures lie buried partially under the newer rocks. Twenty-nine years later, Mr. Godwin Austen read a paper before the Geological Society of London on the possible extension of the coal-measures beneath the south-eastern part of England, in which he set forth the facts in the geological structure of the country; whence he drew the conclusion that there are coal-fields beneath the Oölitic and Cretaceous rocks in the south of England, and that they are near enough to the surface along a certain line to be capable of being worked. He mentioned the Thames Valley and the Weald of Kent and Sussex as possible places where they might be discovered. An inquiry was made between 1866 and 1871 under an official commission, before which Godwin Austen testified. The report of this commission, drawn up by Prof. Prestwich, gave the evidence for and against the existence of the alleged coal-fields. The views of Godwin Austen were fortified by a large series of observations; and the conclusions were reached that coal-fields of the same kind and value as those of Somerset and of northern France and Belgium exist under the newer rocks of the south of England, and that the same measures which disappear in the west under the newer rocks of Somerset reappear in the east from underneath the newer rocks of the Continent. The Sub-Wealden Exploration Committee bored for this coal at Netherfield, from 1871 till 1875, to a depth of 1,905 feet without finding encouragement to go further. In 1886 new borings were begun at Dover. They have been carried on till the present time, to the depth of 1,224 feet. The coal-measures were struck at a depth of 1,204 feet from the surface, and a seam of good blazing coal was met with twenty feet lower. This discovery, Prof. Dawkins says, "establishes the fact that, at a depth of about 1,204 feet from the surface, there is a coal-field lying buried under the newer deposits of southeastern England, and proves up to the hilt the truth of Godwin Austen's hypothesis after a lapse of thirty-five years. The question is finally settled so far as the purely geological and scientific side of it goes." The commercial value of the discovery is next to be estimated. A favorable prognostic is derived from the richness of the corresponding beds on the Continent. The depth is not too great for profitable working, for most of the important coal-pits in England are worked to a greater depth than this, and range to more than 2,800 feet; and one pit at Charleroi in Belgium is worked to a depth of 3,412 feet.

Permanent Value of the High-altitude Cure.—The acclimation of consumptives to the climate of Colorado, and the return of cured patients from high altitudes, were discussed at last year's meeting of the American Climatological Association, in Pueblo, Col. Dr. H. O. Dodge regarded the acclimation of the individual as consisting in overcoming the conditions of altitude and low

density of atmosphere that prevail in mountain regions, and in acquiring the ability to do full labor or take continuous exercise without detriment to the system. The diminished heat at the high altitude, together with the increased tissue-changes consequent on the accelerated circulation and respiration, create an increased demand for food; hence the Coloradan mountaineer is blessed with a keen appetite and vigorous digestion, and, while his store of adipose is usually small, his muscular powers are, as a rule, high. The cool nights promote refreshing sleep, and the dry atmosphere enables one to withstand without inconvenience changes of temperature that in more humid regions would be detrimental or dangerous. The aggregate of persons who become acclimated in Colorado and thereby cured may be divided into three classes, viz.: first, a few who are absolutely cured and who may go to any part of the world or engage in any business, and enjoy an immunity from consumption; those who may go to lower and less favorable climates during certain selected seasons; and those who can not with safety make any change of climate. According to Dr. Dodge's observation and recollection, the first class includes about nine per cent of the patients; the second class, including the first, about fifty per cent; and the third class about fifty per cent. Concerning the safety of a return from the high altitudes after having enjoyed an arrest of the disease, Dr. Frederick I. Knight, of Boston, thought that those who show a strong hereditary tendency to the disease had better be encouraged to remain in the climate where the arrest has taken place. But a patient who has no inherent tendency to this form of disease in himself, but has been the victim, as it were, of external circumstances, may be allowed to try a return under different conditions.

Science at McGill University.—During the past year McGill University, Montreal, has received gifts from citizens of that city aggregating one million dollars, one half of which sum has been given by Mr. William C. McDonald. The larger part of the donations is being expended by the Faculty of Applied Science, of which Prof. H. C. Bovey is dean. A group of new buildings, to accommodate classes in civil, mining, mechanical, and electrical engineering and practical chemistry, will be completed for the reception of students in September. A large additional building for instruction in physics will be in readiness early next year. The laboratories in the engineering departments are provided with the latest and best appliances, including a hundred-ton Wicksteed and a seventy-five-ton Emery machine for strength-testing, a one-ton Faïja spring-tester for cements, a high-speed steam-engine coupled direct to a dynamo for incandescent lighting, and two Thomson electric balances. The museum will contain the Reuleaux collection of kinematic models, the most complete in America. The workshops are fully equipped with machinery of the best and most modern type. Students will be trained in carpentry, turning, pattern-making, smith-work, molding and casting, and in machine tool-work. In the details of buildings, appointments, and curriculum the faculty has endeavored to profit by the examples of the best technical colleges of the United States; in some respects it has succeeded in taking a stride ahead.

The Central Group of the Caucasus.—The central group of the Caucasus Mountains is thus described by Mr. Douglas W. Freshfield: "Elbruz and Kasbek stand some one hundred and twenty miles apart, the former due north of the easternmost bay of the Black Sea, on the edge of the Scythian steppe, the latter in the center of the isthmus overhanging the Dariel road. About midway between these ancient volcanoes the Caucasus culminates in grandeur, in extent of glaciers, and (setting aside Elbruz) in height, in a cluster of magnificent granite peaks and ridges, inclosing great firths of ice which roll gently into the northern valleys, or pour down southward in frozen cataracts till they touch the forests of Suanetia, where they end at an average elevation of seven thousand feet. The snow-level varies between nine thousand five hundred and eleven thousand feet, according to the nature of the soil, the level, and the exposure. Of the peaks, two exceed seventeen thousand feet, and five sixteen thousand feet, while another is higher than Mont Blanc. The longest glacier, the Bezingi Glacier, is ten miles in length—longer than any glacier in the Alps except the Aletsch."

Force of Mushroom Growth.—Dr. A. S. Hudson informs us that several mushrooms have been found growing in the concrete floor of a livery stable in Stockton, Cal. The floor had been laid a little over a year, and consisted of a layer of cement, three or four inches thick, with a top coating of asphalt and gravel. The mushrooms had started in the concrete; one specimen that was examined came from an inch and a quarter below the surface, and had broken through the cement above this point. It grew to about an inch and a half in height, and its stem was three fourths of an inch thick. The mushroom was white, and its texture was as firm as that of a turnip. Where another one had broken through, the fragment of cement forced up was found a foot away. The most probable way of accounting for the presence of the fungi in this very unfavorable situation is that the spawn became mixed with the cement when the floor was laid.

NOTES.

THE Royal Society of Canada met in Montreal, May 27th to June 1st, Principal Grant, of Queen's College, Kingston, presiding. The society was founded by Lord Lorne in 1881, on the lines of the Royal Society of England, combining, however, literary with its scientific sections. Sixty-three papers were read, several of them of high interest. Reports were presented by a score of societies scattered throughout the Dominion, each at work on some branch of natural science, historical research, or literary production. Several delegates from the United States were cordially welcomed; General F. A. Walker, Vice-President of the National Academy of Sciences, representing that body, and Major J. W. Powell, Director of the United States Geological Survey, the learned societies at the national capital.

A NEW arctic expedition has been fitted out at this port, and sailed hence on the 6th of June. It is called the Peary Expedition, from Lieutenant Peary, its commander, and its object is the determination of the northern limit of Greenland, which its leader hopes to reach about the middle of July, 1892.

THE third meeting of the Australasian Association was held in Christchurch, New Zealand, beginning January 15th. Sir James Hector presided. The American Association was represented by Prof. Goodale, of Harvard University, but no representative of the British Association was present. Recommendations were adopted that the sea between Australia and New Zealand be named the Tasman Sea; asking the appointment of a committee by the British and American Associations to define terms of general importance in biology; and that the Little Barrier Island, north of New Zealand, and Resolution Island, on Dusky Sound, be set apart as reserves, where the native fauna and flora of New Zealand may be preserved from destruction. The next meeting of the Association will be held at Hobart, Tasmania, with Sir Robert Hamilton as president.

DISCREPANCIES in the names or in the spelling of them occurring in the surveys of the different departments of the national administration, and the absence of any authority on the subject, have prompted the organization of the United States Board of Geographic Names. Questions which are brought before this board are submitted to its executive committee, which examines the matter, consults authorities, and uses whatever assistance may be available. It then reports to the board, which decides the matter by vote. The first bulletin of the board relates to names in Alaska. The co-operation of all geographers, historians, and other scholars interested in geographical nomenclature is invited in its work.

WHILE local farmers and butchers in the United States are pretending to adduce sanitary reasons for discouraging the use of meat that comes in refrigerating apparatus from a distance, the Lancet uses them in support of the transportation of all meat to the market in that way instead of bringing the cattle alive. It assumes that it would be much fairer to consumers to interdict the importation of living animals as food, and to insist upon receiving carcasses only. This would certainly lead to the abolition of the hardships and sufferings the poor brutes now undergo, would insure better meat, and would avert the introduction of contagious diseases which have already impoverished British agriculture, and which require the maintenance of an expensive system of inspection at ports all round the coast of the country. "The middle-man might perhaps complain; but as he is, so far as we can see, the only one who profits from this stupid and cruel business, we need not consider him in the matter."

MR. STANLEY, in his Darkest Africa, gives Emin Pasha as authority for the statement that the chimpanzees, which visit the plantations of Mswa station at night to steal the fruit, use torches to light the way. "Had I not witnessed this extraordinary spectacle personally," said Emin, "I should never have credited that any of the simians understood the art of making fire. One of these same chimpanzees stole a native drum from the station, and went away pounding merrily on it. They evidently delight in that drum, for I have frequently heard them rattling away at it in the silence of the night."

An International Colonial Exhibition is projected to be held next year in Paris. A peculiar feature will be the geographical rather than political character of the grouping of the sections. Thus, all the West will form one section, India another, and so on. Specimens of all the native populations are to be brought over and housed as at their homes—as is habitually done at the *Jardin d'Acclimatation;* and colonial and ethnographical congresses are to be held.

The objection to cremation that it facilitates poisoning by diminishing the probabilities of detection, was dealt with by M. Frédéric Passy, at a recent meeting of the French Cremation Society. The speaker urged that vegetable poisons vanish rapidly, and, if mineral poisons are used, most of them can be detected in the ashes. Moreover, there are poisons the presence of which in a human body does not prove that a crime has been committed; and, if cremation is generally adopted, greater care will be taken to determine the precise causes of death.

Lake Urumiah, in Persia, 4,100 feet above the sea, is, according to British Consul-General Stewart at Tabriz, the saltest body of water on the earth, being salter than even the Dead Sea. It is eighty-seven miles long and twenty-four miles broad, and contains nearly twenty-two per cent of salt. Its northern coasts are incrusted with a border of salt glistening white in the sun. It is said that no living thing can survive in it, but a small species of jelly-fish manages to maintain an existence in its waters.

According to Mr. Joseph Jibrail, who has been a teacher among them, the most curious beliefs of the Druses are those connected with China, which they regard as a holy land, where they will be reborn when they die. Eclipses are supposed to be caused by a dragon eating a piece of the sun or moon. Some of their beliefs recall those of the early Gnostic and Manichæan sects in Syria.

A curious example of the natural "inarching" of trees exists in Lawrence County, Ill. The trunks of two elm trees, standing about twenty feet apart, have met at about the same distance above the ground, where they blend into a symmetrical trunk of large dimensions. The tree is nearly a hundred feet high, and well developed; and wagons can easily be driven through the great triangle which forms their base.

Mr. Merrifield, a British officer in Tenasserim, says that the belief that the teeth of the Malays and Siamese are colored by chewing betel mixed with lime is an error. The black color is produced by a special process employed for the purpose, for no respectable Siamese would like to have white dogs' teeth like Chinese, Indians, and Europeans. Cocoanut kernel is carefully charred, and then worked to a stiff paste with cocoanut oil. When carefully and regularly worked over the teeth, this produces the black varnish which is so much admired. Among some Malay tribes it is considered the proper thing not only to blacken the teeth, but to file them down to points like sharks' teeth.

The success which has attended the introduction from Australia of the *Vedalia cardinalis* as a remedy for the *Icerya*, or fluted orange-scale, is represented by Prof. C. V. Riley as having been phenomenal. It has fixed the attention of entomologists and of fruit-growers and farmers to the method of dealing with injurious insects by multiplying their enemies; and there is no question but that the cases in which the experiment may be more or less successfully repeated will be numerous. Fears have been expressed lest, after sweeping off the *Icerya* the *Vedalia* will perish for want of food, and the *Icerya* will increase again; but Prof. Riley thinks that this danger will work its own cure by the laws of balances. If the *Icerya* increase, the *Vedalia* will have more food, and will increase again, and so the work will go on, as according to nature.

Water extinguishes fire, not, as the common talk is, by virtue of any incompatibility between the two elements, but partly by the effect of the lowering of the temperature caused by its evaporation, and partly by acting as a mechanical extinguisher. Enveloping the parts of the body upon which it is thrown, it separates the combustible matter from the atmosphere, and cuts off the supply of oxygen—the life of the fire.

M. Berthelot has been investigating the cause of that peculiar and far from unpleasant odor which arises when vegetable soil is moistened. It proves to be produced by a camphor-like substance existing in extremely minute proportions—only a few millionths—exact analysis of which has not been practicable, on account of the small quantity obtainable. The author did not find the alcohol in the soil that M. Muntz claims to have detected there, and regards that found by M. Muntz as only an exceptional product of the spontaneous fermentation of vegetable *débris*. The new odoriferous body has a similar action with alcohol in producing iodoform.

Fromentine is the name of a new food-substance which Dr. Dujardin Beaumetz prepares by extraction from the embryos of grain seeds. On subjecting the mass obtained by collecting the embryos to a slight cooking, the proportion of albuminoid and nitrogenous substances is augmented. The water is evaporated, and the fat is separated by pressure or solution, when as much as fifty per cent of albuminoid matters and twenty-seven per cent of ternary substances are obtained. The new product contains twice as large a proportion of nitrogen as meat.